Australian Model Engineering

November-December 1996

Issue 69

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LOCOMOTIVES, TRACTION & STATIONARY ENGINES, BOATS, WORKSHOP, PRODUCTS, CLUB NEWS & EVENTS, REVIEWS

In This Issue:
- *Toneya* — a 2½" scale Fowler Locomotive
- A Simple Marine Steam Propulsion unit
- How to Add a Clutch to Your Lathe

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November-December 1996 Issue 69

Contents

The Cover

Ross Bishop-Wear's 2½" scale Fowler Locomotive on duty in the high ground. The crew have gone off to a river nearby for a spot of fishing. Meanwhile, you can relax with the story from page 25.

Photo: Ross Bishop-Wear

Australian Model Engineering

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Comment

Good on you, Kiwis!

Whether we like it or not, there is a worldwide trend of bureaucrats wanting to enshrine everything in legislation of one sort or another. This seemingly includes all hobbies and amusements. If legislation relevant to our hobby is enacted unvetted, almost certainly it will lead to unwarranted restrictions in the way we conduct our affairs. This is why enthusiast groups are rallying and forming associations to represent and lobby on their behalf, to ensure that legislation relevant to their hobby is sensible and workable in a practical sense.

With this in mind, several model engineers from the length and breadth of New Zealand have worked tirelessly to get clubs and their members to see the need for a strong national representative body. All this hard work culminated in a meeting at Taupo, in mid June, where a national body was inaugurated.

With the UK, USA and South Africa still struggling to achieve the club unity required to form a strong national body, it is good news indeed to hear that New Zealanders have bitten the bullet and succeeded in forming the Model Engineering Association of New Zealand Inc. The foundation President is Monty George from New Plymouth SMEE and the foundation Secretary/Treasurer is Les Moore from Tauranga M&ME.

May it serve them well and enhance the operational freedoms and safe practices model engineering societies currently enjoy, and will need, to see them into the next century.

Neil Graham

To our new reader

If this is your first issue of Australian Model Engineering, welcome!
We hope you'll look forward to the ideas, news and camaraderie in each bi-monthly issue.
One of the great things about our hobby is the way model engineers actively help each other. Unless you live in an isolated community, you'll soon discover who has valuable experience in your field of interest, or who will help you to make a part that's too big for your workshop machinery. Look in the *Club Roundup* section to find a club that's near to you; pay a visit and you'll usually find model engineers who live not too far away. Then you can experience the great fellowship that makes our hobby special.
This magazine is prepared in the same spirit of "model engineers helping each other". About two dozen people put many hundreds of hours work into each issue — all on a voluntary basis — to help model engineers in Australia and New Zealand keep up to date and stay in touch.
We rely on our readers to write articles for us — for the same (non-existent) rate of pay! If you have ideas or techniques that you feel would be interesting to others, please drop us a line. We'll gladly help with preparation of artwork or editing if that's necessary. Most important of all, please support the people who advertise in our magazine. Without them to pay the bills, you wouldn't be reading this!

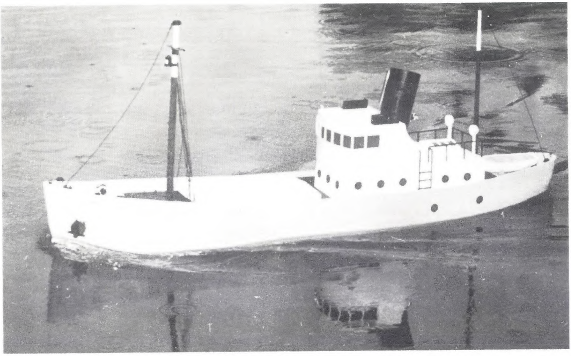
Brian Carter

Marine Steam Propulsion

A Simple and Effective System

by Allan Wallace

Drawings for publication by Allan Wallace. Photo by Brian Carter



I started building the engine for a model tramp steamer during one of those ice ages between locomotive projects. It only took a weekend, but that was the impetus needed to add a boiler, a hull and a simple radio control. Finally, I retro-fitted a variable-pitch propeller system to give the model more maneuverability.

The craft has created quite a bit of interest in the local boating pools because it performs extremely well even in rough and windy weather, despite having a modest power plant for its size. In particular, many folk have been intrigued by the variable

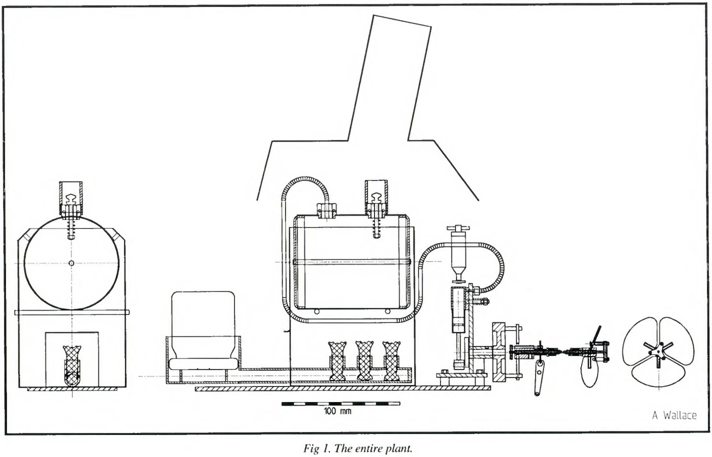


Fig 1. The entire plant.

pitch propeller because of its unusual design.

But there are many other features which have contributed to make it a successful model. I would like to pass on what I have learnt to prospective builders.

Boat

The hull lines are taken from a design for a North Sea trawler, which seems to have a particularly streamlined form. It is 1020 long x 190 mm wide, has a displacement of 7 kg and draws 90 mm of water. The propeller diameter is 60 mm.

I cut a plug from rigid building insulation foam, made a female GRP (fibreglass) mould, and then moulded the final hull in GRP. The decking is 3-ply, and the superstructure made from 1 mm polystyrene sheet. A 10 mm diameter brass bar was glassed along the bottom inside the hull as a keel which could accept tapped holes for bolting down the plant and ballast.

Engine

There is nothing unusual about this single cylinder, single acting oscillating engine. It is fabricated from brass and silver soldered, and has a bore and stroke of 9.5 x 21 mm. I designed it with the smallest practical overhang: the distance from the port face to the cylinder bore axis is only 9 mm. This reduces the overturning moment due to the thrust of the piston, which minimizes the spring pressure required to hold the portface closed. I am convinced that this form of leakage is not often recognized because it is very difficult to see. A bench test with a stroboscope soon shows it up. For those interested in numbers, the required spring force is only 7 N (70g) for a steam pressure of 270 kPa (40psi), so there is very little friction loss.

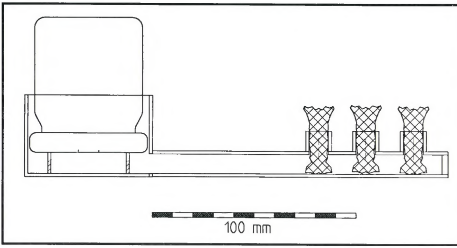


Fig 3. Spirit Burner.

Note also the generous bearing surfaces, a large flywheel and good lubrication. The piston is not packed. Lubrication comes from a traditional displacement lubricator, which I fill with superheat steam oil as used on the locomotives.

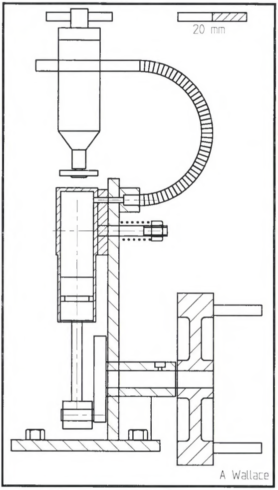


Fig 2. Engine

To keep the boat and the environment cleaner, the exhaust is piped to a small brass reservoir which captures the oil and partially condenses the steam. As in full size, responsible operators should avoid leaving oil slicks behind.

Boiler

The boiler is a simple cylinder 80 diameter x 95 mm long, holding 450 ml. I rolled a piece of 0.75 mm copper sheet around a bottle, made two flanged end plates from 1.6 mm copper, and silver soldered the whole assembly with a 5 mm diameter stay. When filled to 15 mm from the top, it is sufficient for a 45 minute run. There is plenty of heat transfer surface even without water tubes, because the steel housing guides the flames over almost the entire outer surface.

Poor steaming is frequently due to the use of too thick a boiler shell. At the operating pressure of 270 kPa, the circumferential stress in this thin shell is only 15 MPa, which is well below the allowable 26 MPa operating stress.

I did not fit a stop cock, water gauge or pressure gauge. The burner capacity was sized so that the methylated spirit tank is consumed in about 40 minutes, and the flame conveniently goes out before the boiler is dry. Even if the boiler does run dry, no damage is sustained because the spirit burner has insufficient temperature and output to melt the silver solder. It is truly a robust system, and the complication of a boiler feed is avoided.

The safety valve is set to operating pressure, and the burner wicks adjusted so that it is just on the point of blowing off when the engine is driving the propeller at full pitch. Initially, it took me quite a while to figure out why the boat suddenly stopped in the middle of the lake. It turned out that when the safety valve blew, it put the fire out! A shroud on the safety valve fixed that.

The housing is a crucial part of the boiler. It is made of 0.5 mm sheet steel with pop riveted joints. It is really important to allow plenty of air flow but to shield the boiler. Combustion air enters the hull around the edges of a large hatch cover in the foredeck, then enters the boiler housing through a 40 x 40 hole where the burner is inserted. It passes through a gap of 6 mm all around the boiler, and then freely convects into a tinplate hood placed inside the superstructure. Finally, it exits via a 55 mm diameter tinplate funnel, without the aid of a blower or exhaust blast pipe.

Because the boiler is well shrouded there is no need for insulation — in fact almost the entire boiler shell is used for heat transfer from the flame.

For what it's worth (and the thermodynamics says that it's worth a lot), I have run the steam pipe through the flame directly under the boiler shell, providing a high degree of superheat. For this reason, I use a high superheat oil in the lubricator. The main steam pipe is short and is not insulated. The original soft soldered joints quickly failed under the vibration and temperature, so silver soldered joints are used everywhere.

Burner

I chose a spirit fired burner for it's simplicity and safety. As mentioned above, the boiler is immune to the spirit flame even if it runs

dry, and by sizing the spirit tank appropriately, a timed run with a fail-safe shutdown is assured. The only drawbacks of methylated spirits are that the flame is almost invisible in daylight, and that it is hazardous if you spill it, especially from a lit burner. Safe operating procedures must be followed to avoid spillage.

The thermal output can be set by adjusting the length or number of wicks exposed, and is consistent from run to run. This burner uses three wicks each with an exposed area of about 10 diameter x 10 long. They are made of woven glass fibre and have never needed replacing. The capacity of the tank is 125 ml, and it runs for about 40 minutes. I set a stopwatch when the burner is lit, and can reliably bring the boat back in with just a few minutes of fuel left.

The tank is a glass baby food jar with a 12 mm hole in the lid. It operates on the chicken-feeder principle, keeping the spirit level constant in the reservoir supplying the wicks. Using a clear bottle lets one see how much fuel is left. The rest of the burner is made of brass and, of course, silver soldered.

It is advisable to keep the clearance between the jar and the reservoir fairly small to avoid any tendency for the spirit surface to support a flame. I have never experienced a problem with flashback with this setup: this may be due to the strong incoming airflow keeping the reservoir temperature low.

Power Plant Arrangement

The engine and boiler are mounted to a piece of 3.2 mm steel plate, which itself is bolted to the keel. The entire assembly lifts out in seconds by undoing two 5BA screws. The engine is mounted on three spring-loaded bolts, so that fine adjustments can be made to its alignment with the propeller shaft. This was only required once because all the components are located positively in the hull.

Variable Pitch Propeller

Originally, I used a ¼" OD stainless steel stern tube with a ⅛" stainless steel propeller shaft. When I decided to fit a variable pitch propeller, I fitted it into the same geometry. To do this, I adopted a 2mm rod running within a hollow propeller shaft.

At the inboard end, the engine drives the shaft via the common two-pin and cross-bar coupling. While these couplings can tolerate substantial misalignment, I took great pains to get precise alignment by adjusting three support bolts on the engine baseplate. This leads to a very smooth running assembly. To eliminate the torsional jolting when the single-acting engine is running up, there is a little O ring looped over one pin to hold the bar against it.

Arrangement

The inboard end of the pitch actuator rod screws into a small disk into which is soldered three 10BA push rods. These lead back to a PTFE actuator disk which slides axially under the control of a fork mounted on a side bracket. In turn, the fork is moved by a radio controlled servo via a bowden cable. At the outboard end, the pitch control rod emerges into a three-pointed star which also carries three 10BA push rods, one for each propeller blade. The forward end of these push rods pass through elongated holes in the blades and simply twist the blades around radial pivots.

The propeller hub was made from a short piece of ¼ 1/4" AF hexagon stainless steel, and the blade pivots are 1/16" diameter pegs silver soldered in. The blades are of 1.2 mm brass plate and carry 1/16" bore sockets to suit the pins. They are retained against coming off the pins by the pitch changing push rods.

It is not a precision pitch control device, and exhibits some backlash in the zero pitch position, but this is of no consequence in operation.

I have left the blades flat in the absence of any better idea. Since they are thin, any curvature would tend to penalize performance in one direction while enhancing it in the other. In practice the top cruising speed of the craft is probably more appropriate to a naval vessel than a tramp steamer.

I trust that these notes will help other modellers working on similar craft. The drawing can mostly be scaled. Interested readers can obtain a better copy from me via the editors.

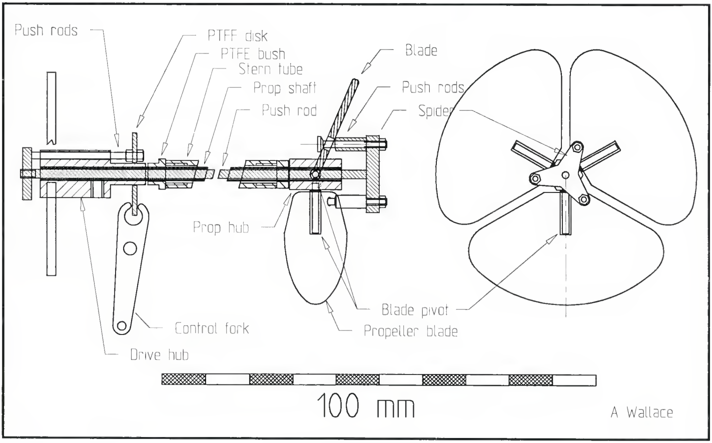


Fig 4. Variable Pitch Propeller

Classic Steam and Power of the Past Rally

by Dave Harper

Over the weekend of 1st and 2nd June 1996 The Queensland Steam and Vintage Machinery Society Inc. held their annual rally at the North Pine Country Park at Petrie, just North of Brisbane.

Due to the general financial situation we were unable to raise funds to ship visiting traction engines etc. from around SE Qld as we have in past years. However, a large number of vintage cars and commercial vehicles arrived over the weekend and more than made up in numbers, if not quite in spectacle, for the missing steamers.

We were also fortunate to have a magnificent fairground organ, the Australia Fair, operating on the Sunday, which certainly gave the whole place a period atmosphere with its rousing music.

We only had a few model traction engines, but a welcome first-time visitor was Peter Smith from northern NSW with his magnificent 4½" scale Allchin, see **photo 1**.

Photo 1.

The Sirius generator set

Another first timer was David Brownsley, whom readers may remember was looking for someone to translate, from Dutch language, some articles on the rare Sirius-Alco steam generating set he was exhibiting (**photo 2**). I'm pleased to say that Petra Cummings (wife of our Garratt Gossip editor) has done the job for us, and very well she did it too!

For those unfamiliar with the subject, these little generating sets were supplied to resistance groups in many theatres of WW2 to enable them to silently charge their radio batteries. A Dutch war museum had sent David copies of some articles on a unit they have from the Dutch underground, and finally we know the whole story!

The Sirius engine was developed and produced by Stuart Turner, and I believe the plans and castings are still available. Several articles on the sets have appeared in the UK Model Engineer over the years.

A model selection

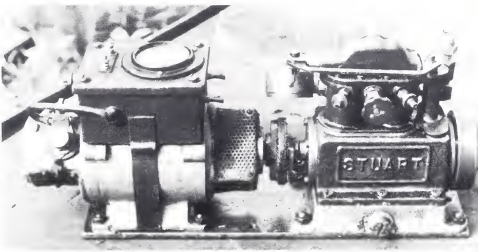
A visitor to our rally was Ron Harris. This year he displayed, among his usual immaculate collection, a Westinghouse pump.

Photo 3 shows Ron's Westinghouse pump and accessories on display.

The Triple S Model Boat Group had their usual excellent display of steam launches, **photo 4** shows part of their line-up.

Ted Dowding is a lively octogenarian from Brisbane's Bayside and we were pleased to have him displaying his magnificent Watt-type beam engine running off its own vertical boiler (**photo 5**).

Ted also does a neat line in model hit-and-miss IC engines; **photo 6** shows one driving a little centrifugal water pump. Incidentally, Ted makes all his own patterns and castings, a remarkable modeller!



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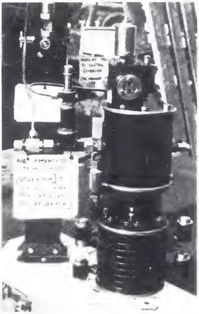

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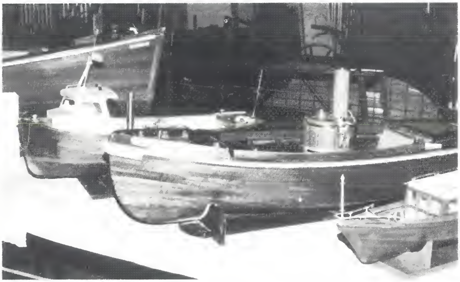
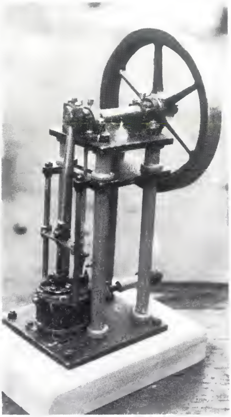


Photo 4.

Bill Davies and his wife Vera are regular visitors to our rally, and this year Bill was proudly showing off his model of our Stewart mill engine, the centrepiece of the QSVMS collection here at Petrie. Having to draw and build the whole thing from scratch, this is quite an achievement, and **photos 7** and **8** show how well he did it! From memory, the model has bore and stroke of 1" and 2" respectively.

Another of Bill's models that caught my eye was the neat little vertical (table?) engine shown in **photo 9**.

Outside the shed, there was loads of activity going on, and during setting up on the Saturday I took my life in my hands and climbed the tower beside the Fire Brigade Museum



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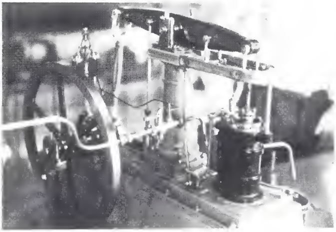

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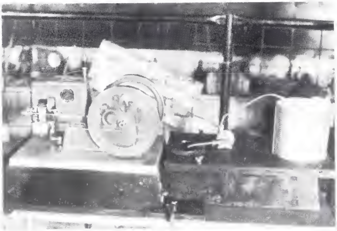

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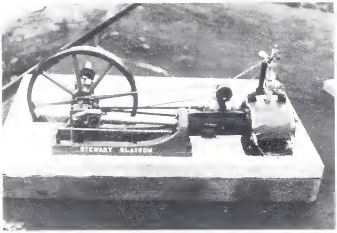

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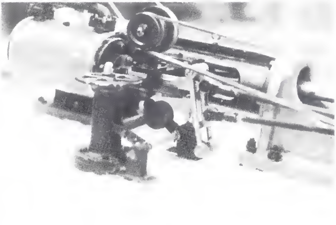

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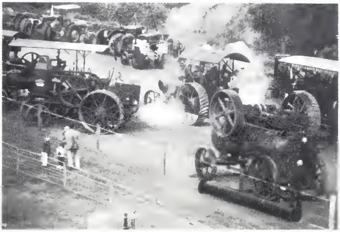


Photo 10.

Photo 11.

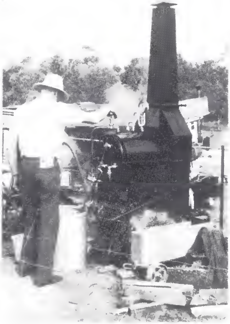


Photo 12.

Photo 13.

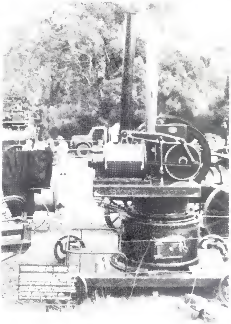


Photo 14.

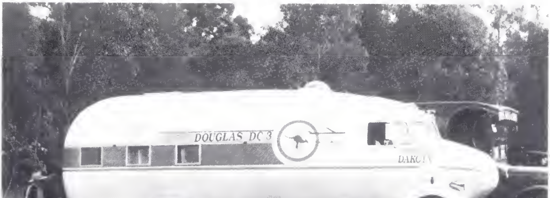


Photo 15.

adjacent to the Boiler House. Photos 10 and 11 show the great perspective this vantage point gave me, despite the shower of rain that came along at that moment!

Photo 10 shows the 1903 Marshall compound traction engine Jennifer passing behind the huge 16hp Garrett portable of Bob Bone and the Rumely Oil-Pull tractor of Ian Fordyce.

Photo 11 shows steam at work; Tony Buchanan's Robey portable driving Bob Bone's Marshall Threshing machine and Neil Coster's portable driving a chaff-cutter. On the left is Reg Schuster's display which I

thought worth a close-up, see photos 12, 13 and 14.

Photo 12 shows Reg, tending his neat underfired boiler which powered several engines including the delightful Tangye vertical in **photo 13**.

I always go cross-eyed watching the strange motion of the Robinson hot air engine in **photo 14**! The combined vertical, horizontal and rotary motions, all set off simply by lighting the fire underneath, seem to defy all logic!

Pick of all the vintage vehicles was Werner Kroll's amazing conversion of a DC3 fuselage into a roadworthy truck which is in fact a mobile home! There must be quite a story there somewhere!

Photo 16.

Finally, a real period set piece; on the Saturday night we had our traditional dinner, but this year we were able to have it in the fine atmosphere of Paul and Navarra Gothard's recreated North Pine Hotel. Late in the afternoon we drove all the steam engines round to the pub for a photo session and **photo 16** shows them all letting rip with their whistles, which really woke everybody up! A pretty rare sight these days and one we'll long remember, it was the highlight of a most enjoyable weekend.

Solar Powered Signals

by K.W.L. Hampel

In 1994 it was decided to extend the main line of the Morphett Vale Railway (South Australia). The first part of this extension was an additional 200 metres where the extended main line would join the loop bypass at the *Algebuckna* Bridge. The bridge strength would not allow double track so it was decided to use the gauntlet method by which both tracks would merge before the bridge and separate again after the bridge.

For the safe passage of trains through this arrangement it was important to employ the use of train approach automatic colour light signals, the power supply for this system was available some 200 metres away at the station!

The cost of putting 240 volt AC to a distribution point at the bridge was about $3000 — which we did not have.

I looked for an alternative, and by a strange coincidence a club member had his camper van at the club one day and he spoke about using solar power his fridge, TV etc. when on holiday, I was very interested and was given the address of a business called BP SOLAR, Prospect, SA. I visited the company and discussed my idea. I conveyed the proposed idea to a meeting of the club and was given the all-clear to purchase the necessary equipment.

- Solar panel "BP 1230 SR" 30 Watt, 12 Volt, 2.1 Amp. $377
- "BPR" 12 Volt, 10 Amp Regulator. $79
- Two ammeters and one voltmeter. $135

Before my retirement from the STA as a Locomotive Railcar Running Inspector I purchased a tapered station platform lighting pole. the pole was used to mount the solar panel — putting it 6.7 metres high. I also purchased a metal AWS box used to house the signal train safety equipment, this is now placed along side the solar pole and will house the 130 amp HR battery together with Voltmeter, Ammeter and isolating switches.

It is hoped to have all the track signalling operating with solar power.

***Photo right**: The solar mast in place on the Morphett Vale Railway. A sign of things to come!*

Club Roundup

Wanganui NZ

The AGM saw all existing officers returned for another year. They must be doing a good job! In the first annual report of the combined model railway and engineering society, club President Alan Morris reflected on the successful merger of the two clubs. He also noted good progress on the new model railway layout and that the model engineers' track was under water for most of the year.

Meetings proliferate at the expense of other club activities with a committee meeting on 2nd Tuesday, Railway Modellers on 3rd Tuesday and Engineering on 4th Tuesday. To allow more time for activities it has been decided for a trial period of a year that the two group meetings are for hobby functions and that each group will receive a report from the committee meeting taking no more than 30 minutes. The club magazine will be two monthly rather than quarterly.

The club display gained 2nd place in the Easter Convention in Palmerston North and firewood sales have given finances a good lift.

Wanganui Model Railway and Engineering Society Inc

Location : 70A Alma Road, Wanganui

Public Running: Unknown

Galston NSW

HME members have decided against the exclusive use of vacuum brakes on the Galston Valley Railway. Instead they have opted for a general performance standard for all types of braking. The key points of the standard are:

- Driver, under normal conditions to control braking of whole train excl. hand brakes on cars behind him
- An indicator to show driver the status of the train brake system
- A train in motion under optimum conditions, upon application of brake by driver to come to a complete stop within 10 metres
- Guard to be able to control at least train brakes on train of two or more cars
- A train in motion with power on under optimum conditions, upon application of brake by guard to come to a complete stop within 20 metres
- A train of two or more cars under optimum conditions parts, both sections to come to complete stop without derailing within 20 metres and hold stationary for minimum of two minutes without assistance.
- Failure of brakes on one vehicle not to affect brake operation on remainder of train
- Brakes shall not act directly on the rails

These points will be the basis of a final standard to be accepted by the members and will give visitors to the club an idea of what is expected. The GVR is aiming for added safety on its substantially graded track.

The Buy, Sell and Swap scheme has been beneficial to members over the past year and a few of them have joined the Bereavement Assistance Scheme.

The Craft Stall has made a substantial contribution to club finances and membership fluctuates at a healthy level.

Hornsby Model Engineers Co-op Limited

Location : 29 Mid Dural Road, Galston

Public Running: 2nd Sunday

Auckland NZ

Members have opted for a change of format for meetings. They will still start at 7.30 pm with an informal natter and inspection of parts etc. the formal session will commence at 8.00 followed by 'Bits and Pieces' and supper.

The clubhouse has been fitted with a deadlock as a result of unauthorised use of clubrooms with doors left open and heaters and lights left on. The library contains some very valuable material and much of this is gradually being transferred to a fireproof archive room. A site has been selected for a new ticket box and some heavy work is imminent.

Like most New Zealand clubs, ASME members are very involved in the submission process with regard to the proposed OSH regulations for the safe operation of amusement devices.

Auckland Society of Model Engineers Inc.

Location : Peterson Road Reserve, Waipuna Road, Panmure

Public Running: Every Sunday

Durban, South Africa

The search for appropriate safety standards and regulations is not unique to Aussies and Kiwis. Durban members are going through similar exercises with other clubs with the current emphasis on boiler testing and certification.

Perfect weather and a radio advertisement... the recipe for the best ever public day with record passenger numbers. That is what happened mid year at the DSME track at Virginia. One problem was the small number of steamers on the track. Many of the public stated that they came specifically to see the steamers.

The Durban SME was founded 83 years ago in 1913. Intending visitors can contact the club through Secretary John Goddard on (031)257885 (home) or (031)3001131 (work) or write to him at 73 Levenhall Road, Glenmore 4001

Durban Society of Model Engineers

Location : Kellaway Hall, Hinton Grove, Virginia

Public Running: 2nd Sunday

Upper Hutt NZ

Richard Hatfield holds the position of President and Bob Begbie is Secretary/Treasurer of Maidstone MES after the last AGM.

The 7¼"g track is becoming a reality now that steel has been purchased and fabrication of rail sections is underway. The club has been invited to participate in discussions with Council on future development of the area and the possibility of future extensions. The second open day of the year saw a good turnout of visitors and locos from neighbouring clubs

Maidstone Model Engineering Society Inc

Location : Maidstone Park, Upper Hutt

Public Running: Unknown

Paraparaumu NZ

Track running has been at the mercy of the weather as usual. On more agreeable days good crowds have turned out. Some maintenance has carried out. Ground has been prepared for the additional carriage siding which also involved moving the fence about 1.7 metres. The footbridge has been painted and some repairs done to it.

Paraparaumu Associated Modellers Inc

Location : Marine Gardens Railway, Raumati Beach

Public Running: Every Saturday and Sunday (weather permitting)

Club Roundup contributions

AME is pleased to receive club newsletters for consideration in this section. Newsletters are often a good source of articles, which we appreciate all the more, but most of all they help us keep in touch.

It is often difficult to decide what to publish and what to leave out. and the task of selecting material for a wider audience takes a lot of time. Also, there is always the risk that AME will publish something that the club considers sensitive. Please help by sending a "press release" page with your newsletter, or highlight the items you think we could use. We'll give first preference to clubs that help us out this way.

bmc

West Ryde NSW

There is renewed interest in the elevated track now that the stub points and associated signals are in use. The Relph disc signal is currently the only working example known, and the lower quadrants (including one reverser worked) completes a working system that is quite rare in preservation circles. Some work has been done in preparation of extending the channel iron to work the crossover points, fencing of the tracks has continued and gates at the pedestrian crossing have addressed the problem of people walking in front of trains. Some trackwork has been commenced with the long awaited yard rearrangement under way which will provide greater flexibility. The extending of the shunting neck has proven beneficial.

Bill Richards, former president, director and current ground level track superintendent, was awarded Life Membership of the SLSLS. As a side note, Bill pioneered the idea of 1⅛" to 1' scale and the development of the wheel standards used at West Ryde and subsequently adopted by the AALS.

Sydney Live Steam Locomotive Society
Location: Anthony Road, West Ryde
Public Running: 3rd Saturday

Nelson NZ

The big news is the new clubhouse, for which funding is being arranged and plans finalised. The new building will be very impressive with members lounge, library, modelling hall, suspended 00 gauge layout, storerooms and kitchen.

Over the past few months the track has been re-aligned to provide smooth running with the new passenger cars. A few trees were felled in the winter to allow some sunlight through, especially up the back straight where it is always cold and damp. A new drain has been installed in the steaming bays which are now high and dry in the heaviest of rain.

Nelson Society of Modellers Inc
Location: adjacent to Tahunanui Beach, Walkare Street, Nelson
Public Running: Every Sunday

Eltham Vic

Two new locos to run on DVR? Members are considering the purchase of two additional locos for the DVR, a Petrol Electric AN CLP outline and a Hydraulic SRA Bi-centennial 81 class.

Committee meetings are now on the 2nd Friday at 7.00 pm and Members Sub-Committee Meetings on 1st Sunday at 7.00 pm. Train Crew Rostering is being trialed and the new building is named Meadmore Junction Signal Box.

The Ways and Works people have re-aligned and extended No.1 road of East Yards and are doing the same to No.2 road. The Signals Branch are working on the interlocking board for Meadmore Junction and the Rolling Stock Branch have had GM12 out on test runs, after nearly eight years in the workshops.

Diamond Valley Railway Inc
Location: Eltham Lower Park, Main Road, Eltham
Public Running: Every Sunday

Millswood SA

Millswood Station is to be officially named by club patron The Hon. Diana Laidlaw MLC at the exhibition in November as part of the celebrations to mark SASMEE Park's 50th Anniversary. New 7¼" points, in use for some months, will be connected to the new loop to pass Millswood Station.

New signals are being installed at SASMEE and being based on a prototype railway design add a touch of realism. They are colour light and include all the features one would expect including small shunting indicators at the bottom.

Member Bert Francis was awarded Best Steam Road Vehicle prize at the 1996 convention.

South Australian Society of Model and Experimental Engineers Inc
Location: off Millswood Crescent, Millswood
Public Running: 1st Sunday and 3rd Saturday

Tauranga NZ

Members have suggested that the Council replace the willow trees with native ones, the willows having already been removed. The Council is keen and has asked them to recommend suitable species.

Well known railway historian Allan Bellamy gave a talk on the development of steam locomotives in New Zealand at the June meeting. There was a good attendance on a very chilly night for what was an informative and enjoyable evening.

Expo 98 continues to be the major focus and plans are right on track.

Tauranga Model Marine and Engineering Club
Location: Memorial Park, Tauranga
Public Running: every Sunday

Wollongong NSW

The second Annual Hot Pot Run was a great weekend... if you missed it, don't despair it will be on again next year. The weather was perfect unlike the memorable westerly winds last year. *See the report elsewhere in this issue... ed.*

The whole board was returned at the AGM, so they must be doing something right. It has also been decided that after many years service and "hard yakka" the Portable Track will no longer be offered for hire.

Illawarra Live Steamers Co-op Ltd
Location: *Stuart Park*, Westside Squires Way, North Wollongong
Public Running: 4th Sunday

Canberra ACT

Canberra SMEE members were amazed at the number of model engineers who turned up for their September AALS Inter-Club Run — accompanied by partners who headed straight off to see the spring flower festival, *Floriade*. The club's new president, John Nicolson, was embarrassed that only four of the many tulips planted at the track had bloomed, but that was the only thing that went wrong!

Visitors this year came from as far afield as Melbourne and Ipswich. Seventy-five people rolled up for the spit roast dinner, served on the platform at the adjacent ARHS railway museum and eaten aboard the museum's dining cars. The nostalgic sleeping car accommodation was popular, as always.

New track facilities minimized hold-ups for the 20 locos that operated on the weekend. Scale NSW 5" gauge locos were abundant. Ian Smith's Bundaberg 7¼" gauge Fowler 0-6-2, *Bunyip*, won the Fisher Discounts prize for the most popular loco. A photo of *Bunyip*, driven by a local MP, appeared in *The Canberra Times* on the Sunday — complete with political commentary!

This event's popularity is "on the up and up", not least because there are plenty of activities nearby for the non-model engineering visitors.

Canberra Society of Model and Experimental Engineers Inc
Location: Geijera Place, Kingston.
Public running: last Sunday.

Coming Events

2, 3 November
SASMEE Park 50th Anniversary
SASMEE are celebrating their 50th year at SASMEE Park by holding a commemorative exhibition. Secretary Ian Clark, PO Box 208, Goodwood. SA 5034

2, 3 November
Invitation Run-Wagga Wagga NSW
Come and join in the annual get-together and hospitality of the WWSME. The traction engine track is now operational so come and try it out!
For further details contact: David Font, (069) 21 4762.

24 November
Invitation run and open day
Maidstone MES, Upper Hutt, NZ.

22, 23 February 1997
5th Annual Invitation Run
Lake Macquarie LSLS 45th birthday
Off Velinda St. Edgeworth.

28 to 31 March
AALS Convention, Cobden, Vic
Organising Sec. Alan Hart.

8 to 12 January 1998
International Model Engineering Expo, Tauranga NZ
Model exhibition, hobby displays, working demos, road vehicles, railways 2½", 3½", 5" and 7¼" gauges.
Contact **Expo 98** Secretary, 326A Devonport Road, Tauranga NZ

Steam Chest

with Dave Harper

Welcome to another selection of steam stuff. As promised last issue, there's more from Burgh's *Modern Marine Engineering* of 1872 plus details of a remarkable model in the making.

The selection from Burgh this time is a set of Annular Compound Engines of 350 HP collectively as fitted in the Mail Steamer *Ruahine* which was built by Messrs J W Dudgeon of Millwall, London.

Historical note

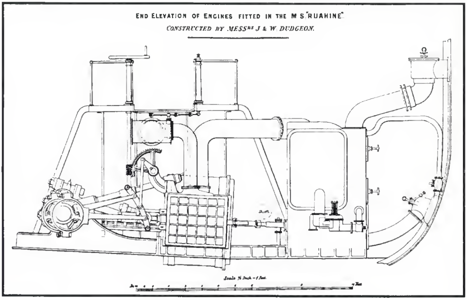
As an historical note, the River Thames at that time was a major shipbuilding area, and in the 1850s I. K. Brunel's *Great Eastern* was built there. The Thames at that time was also virtually a huge open sewer with the majority of London's effluent swilling up and down with the tides.

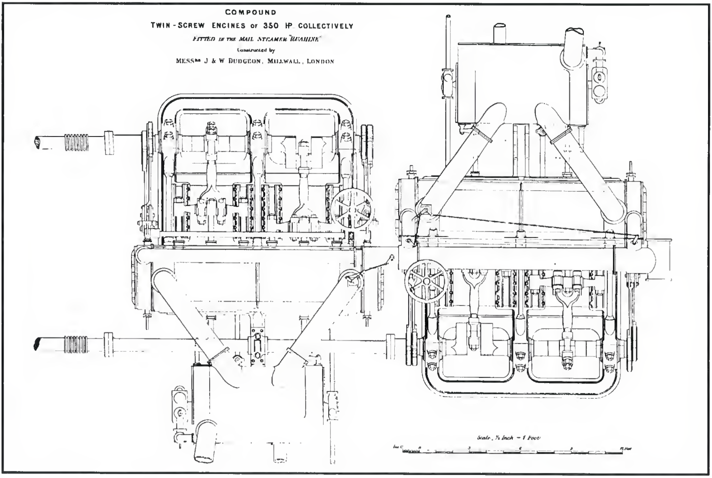
Working in this noisome environment was definitely a health hazard, and Brunel's health was badly affected during the months he spent trying to launch the ill-fated *Great Eastern*. In fact he died in 1859 before the great ships' maiden voyage — end of historical note.

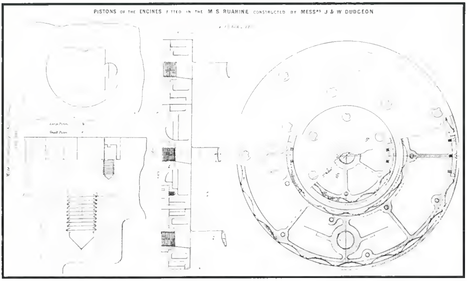
The *Ruahine*

To return to the *Ruahine*, the ship was 288ft long, 34ft beam and 27ft deep. At 90RPM the engines developed an indicated 1540HP and achieved 13 knots. Fuel consumption was 2.667lbs of coal per horsepower per hour.

Dimensions of the engines are on the Brobdignagian scale of marine engines of that



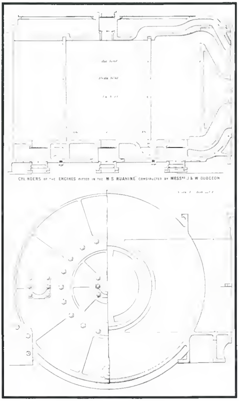


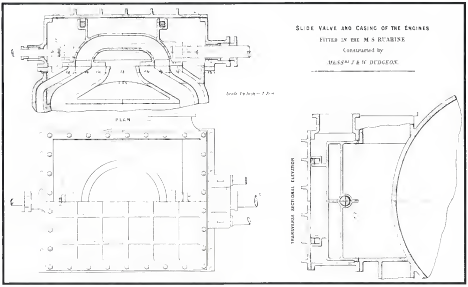


era: the LP cylinder was 62" dia, the HP cylinder, which was actually in the centre of the LP cylinder, was 27" dia, and stroke was 24".

The piston, which was 8" thick, had three piston rods, one in the centre on the HP and one each side on the LP piston. They were connected to a common crosshead which drove the 48" long con-rod, which was 9⅝" dia. The crankshaft bearings were 9⅝" dia and 18¾" long!

The air pump was driven by a tailrod on the HP piston.





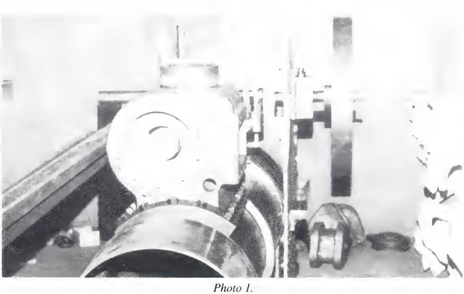


Photo 1.

The slide valves were multi-ported and worked in a steam chest 27" wide, 3'6½" long and 1'3" deep. The valves had a large bearing ring on the back of them to reduce the area exposed to the steam and thus reduce friction.

Where does the steam go?

Working out the steam paths is an interesting exercise... taking the piston at the outer end of its stroke, the steam enters the outer end of the HP cylinder; meantime the inner end of the HP cylinder exhausts into the outer end of the LP cylinder and the inner end of the LP exhausts to the condenser.

Casting the steam passages must have given the pattern makers and founders food for thought!

The five drawings show the layout and details clearly enough to need further explanation.

And there's more!

I don't think there were many annular compound engines built, though I'd be glad to hear of any others... imagine my surprise when I mentioned the subject to Chris Wilson, one of my fellow members in the Qld Steam & Vintage Machinery Society, (QSVMS) and he invited me over to see the one he was building!

It turned out to be a 6" scale model of an 1898 Savage Centre Engine which Chris has been working on for some time. I was aware of this, but hadn't realized that it was an annular compound!

Needless to say, I didn't take much persuading to turn up at Chris's place armed with camera!

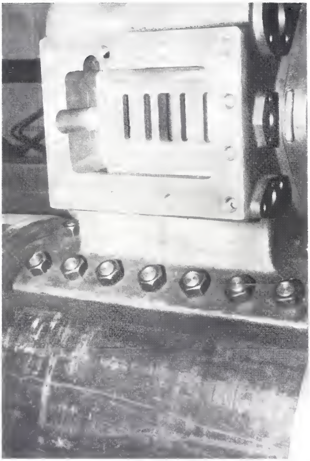


Photo 2.

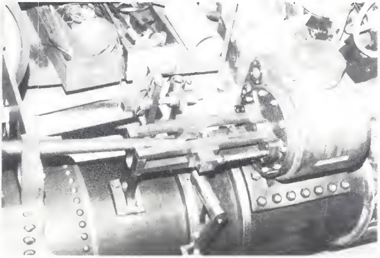


Photo 3.

It seems that in the 1890s Savage's of Kings Lynn, Norfolk, England, built a number of centre engines which were essentially a traction engine that could be turned into a carousel, or gallopers as they were known. Three of these were built with annular compound engines, and Chris, ever looking for a challenge, decided to build a half-size one that could carry people on slightly over-scale horses. The only information he has comes from a book *Steam Engine Builders of Norfolk* by R. H. Clark. There is very little detail information even there, so Chris has virtually designed the whole thing himself.

In doing so he has utilized ball and roller bearings wherever possible while retaining the look of the original.

Betwixt and between

On top of this he ran into a real problem with the boiler; it is too small to comply with the commercial regulations, and too big for the AMBSC code! Consequently he decided to make a false scale boiler with a working Briggs type steel boiler that fits inside it. This has had several benefits in that the engine can be bolted to the false boiler and the real boiler can fairly easily be removed for inspection etc.

Pictorial proof!

My attempts at photography in the confines of Chris's workshop were quite pleasing, and **photo 1** is a view from the front that clearly shows the annular piston arrangement.

The LP piston is $6\frac{3}{8}$" dia, HP is 3" dia and stroke is 6". The inner bore of the LP piston is $4\frac{1}{2}$" allowing for the steel tube which fits between the pistons and is retained by the cylinder head. The LP piston has rings on the inside as well as the outside!

Photo 5.

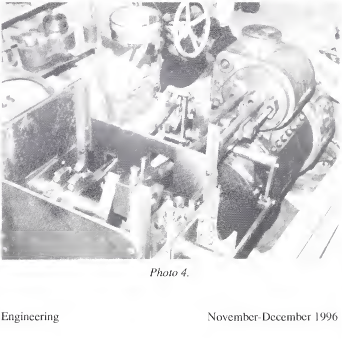


Photo 4.

Photo 2 shows the multiple steam ports in the steam chest, a masterpiece of casting and machining! Chris makes all his own patterns, incidentally.

Photo 3 shows the crosshead arrangement, also the valve linkage and governor mount which is complete with ball race.

Photo 4 is a shot from the rear showing the crankshaft which is in two halves and runs in roller bearings.

Photo 5 is of bits yet to do... wheel hub castings, chimney top ring, large roller bearings for the carousel pivot, the steering worm and wheel and in the cube, the bevel gears for the carousel drive.

Last but by no means least, **photo 6** shows the horses so far. Built by a local rocking horse maker, who Chris says had always wanted to make a set of gallopers, there will be ten on the finished ride, all painted and gilded just like the originals.

Altogether a fascinating and ambitious project which will keep Chris busy for quite a while yet. I'll keep you posted on progress!

Local news

Life has been pretty hectic as usual at Petrie, home of QSVMS, with engines going off to Caboolture for the Antique Machinery Fair in July and to Jondaryan Woolshed for their Heritage Festival at the end of August.

I also passed on the information on the Willans engine (mentioned last issue) to Chris Lloyd at the Queensland Museum, for which he was very grateful as they have very little information on what turns out to be a pretty rare engine.

I've also had several welcome visitors at our Boiler House museum, including Peter Hall from Kingaroy, who was one of several readers who responded with information on turbine pumps.

Other good news is that Dave Sampson, whose models have graced this column previously, has joined our society and brings some of his models along on our steaming days.

That seems to be more than enough for this time, so until next issue, happy steaming!

Photo 6.

Hot Pot Run '96

by Ross Edmondson

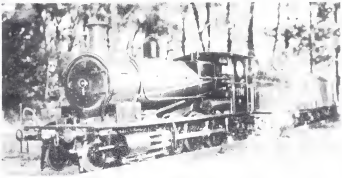
Over the Queens Birthday weekend, 8 - 10 June the ILS staged the Annual Hot Pot Run for the second time. No doubt those of you who attended the first run in 1995 will remember the westerly winds which tried to blow Wollongong off the map well, this year was the complete opposite with near-perfect weather.

There was a good roll up of visitors with 307 signing the Register accompanied with 35 loco's and an abundance of rolling stock. There were double-headers, triple-headers, coal hoppers, S trucks, mixed goods and a few passenger trains going in every direction, in all a great weekend. It's pleasing to note that the some of the Victorians are getting in on the act as there were 12 of them! They turned up with a *Nigel Gresley* and a rake of VR rolling stock which clocked up quite a few miles over the weekend.

Attacking the hill as Dallas King, obscured by the safetys lifting on 3801, double heading with Craig Hill driving 3805 with 54 scale wagons in tow!
Photo: Steve Griffin

Bernie Courtenay from the Ryde Society had his South Maitland Railways 10 Class on display — all it needs to finish it off is a coat of paint. Parked along side from the Moorabbin Club was Mel Skinner's AD60 Class Beyer Garrett, which is being constructed at 1⅛" scale and after four years it is about 40% finished. Mel is using Railway drawings and the front and rear engine are up on the feet with coupling and connecting rods all in place with needle roller bearings throughout. The front and rear tanks, nowhere near finished yet, all in brass with a mountain of 3/64" rivets all in nice straight rows. According to Mel he says the loco will be finished at Christmas, but he's not saying which one! *See AME issue 68 page 14 for 60 class photos... ed.*

These two eye catching loco's had everyone in raptures and I feel quite sure that it will take their owners a week or so to get the slobber off them as there was always someone there drooling all over them. The workmanship in both of these loco's is first class and it is a credit to the builders, but the only problem is that they're in the wrong workshop!

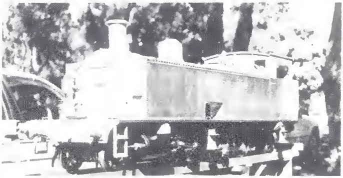


Barry Potter's 5201 hauling a rake of scale wagons.
Photo: Brian Carter

From all reports the multitude devoured 214 tins on soup along with 500 bread rolls plus a lot of tea and coffee and a great time was had by all. Late on Monday afternoon there was still about 45 tins of soup left over and after a General Meeting in the steaming bays it was resolved that they be donated to the Wesley Mission.

It was late on Sunday afternoon before things started to get into top gear with Dallas King, (Lake Macquarie) on board 3801 double heading with Craig Hill (Blue Mountains) on board 3805 when they coupled up everything in the yard and let them go, a total of 54 wagons behind them in various shapes and sizes. Not long after, it was decided to remove 3801 and see if one engine, 3805, could pull the load on its own and that's when Ross Bishop-Wear prised Craig Hill off the drivers seat and really gave it heaps! The hardest part was to actually lift the load but once the wheels started turning it was no problem for the 38. Shortly after it was open slather for all and sundry to have a go and there was no shortage of engines or drivers to test their skill. In all a you-beaut weekend, sure beats the pants off going to work!

Soup's on! Ian Kirby (left) tops up the pot while Ross Edmondson (centre) blends the ingredients. Barry Glover gives it the taste test!
Photo: Brian Carter



Bernie Courtenay's SMR 10 Class.
Photo: Brian Carter

Repairs to Locomotive Boilers on the Victorian Railways

Procedure when Fusing of Lead Plugs in a Locomotive Boiler Occurs

by Doug Baxter

This installment takes us through the procedures to follow if the lead plugs (fusible plugs) fuse in a boiler. The main cause is low water in the boiler, but the severity of the damage is subject to the skill of the driver. After a fusing, the boiler inspectors have reports to file — these are explained below. To clarify the topic, the following extracts have been taken from the *Rolling Stock Book of Instructions.*

128

(a) In every case of the fusing of a lead plug in a locomotive or other boiler the Driver or other employee in charge of the locomotive or boiler must immediately draw the fire.

(b) The employee in charge of the boiler must immediately notify his Superior Officer and if at a Depot or on a locomotive in service the Chief Mechanical Engineer, the Superintendent of Locomotive Running and the District Rolling Stock Superintendent must be notified at once by telephone or telegraph.

129 In every case a special investigation is to be made immediately into all the circumstances of the case by the district Rolling Stock Superintendent and the Boiler Inspector in every case at a Depot or on a locomotive in service.

130 In every case the following procedure must be carried out:

(a) The locomotive concerned is to be impounded and nothing must be done to the engine, or any of the Boiler Mountings, until the Boiler Inspector has made an examination and given permission for the engine to be lit up.

(b) After the Boiler Inspector has given this permission, the boiler must be filled to a half-glass and a fire placed in the firebox. When steam has been raised, the gauge glasses and the boiler mountings must be thoroughly tested and examined by the District Rolling Stock Superintendent or Depot Foreman in the manner set out hereunder:
The gauge glass steam cocks on top of the boiler must be tested to see that each one is fully open and each gauge glass, mounting, and union nut must be thoroughly examined for signs of leakage of steam or water. Each gauge glass must be tested as set out below:

(i) The straight handle of the bottom mounting must be turned fully to the right to give steam passage a blow through to the drain pipe.

(ii) The straight handle must then be turned fully to the left; the water should rise smartly in the glass. If the water rises slowly it indicates that the water passage in partially blocked.

(iii) The steam cock on the top of the boiler must then be closed; the water should rise in the glass until the top of the water is out of sight.

(iv) The straight handle must then be turned slightly to the right to give the water passage a blow through to the drain pipe.

(v) The straight handle must then be turned to the left and the water should again rise until the top of the water is out of sight.

(vi) The steam cock on top of the boiler must then be opened to its fullest extent; the water should return quickly to its former level in the glass. If the water settles back slowly, the steam passage is partially choked.

(c) Each gauge glass on the locomotive is to be tested separately as set out above. This test is to be made with the gauge glasses, cock and mountings in the same condition as when the fusing of the lead plug occurred The height of the water in each glass is to be measured before the test is commenced and after it is completed and the measurement recorded.

(d) The gauges are then removed, but no attention is to be given to the mountings, and new or reconditioned glasses placed in the mountings and and the tests as set out above repeated, the height of the water in each glass to be again measured and recorded before and after the test.

(e) An engine of the same class and type as the one on which the fusing of the lead plugs occurred is then selected and the gauge glasses of this engine tested, and the height of the water in each glass measured and recorded.

(f) The gauges glasses which were in use on the engine on which the fusing of the lead plug or lead plugs occurred are then to be fitted to the selected engine and tested. The height of the water in each glass is to measured and recorded.

(g) It is to be clearly understood that while No.1 or No.2 series of tests are being made on the respective engines water must not be fed into the boiler of either engine.

(h) The gauge glass mountings of the engine concerned in the fusing of the lead plugs are then to be removed and thoroughly examined, and their condition recorded. Should the tests indicate any defect such as steam or water passages partially choked or irregular water levels, then a special examination is to be made to locate the cause of the defect.

(i) Full reports of the circumstances in regard to the fusing of the plugs, together with the result of the examination of the boiler and firebox and the results of the tests, are to be forwarded to the Chief Mechanical Engineer.

Reports

The Boiler Inspectors report would be as follows:

"Acting under instructions I examined the Boiler Reg. No... in the frame of engine K... located at... and report the following result. On removing the centre washout plug on the backplate, the hight of water was ascertained to be four inches below the crown, there was three feet of water in the tender tank. On entering the firebox the following was observed, leading plug completely fused, trailing plug partially fused, top row of flues showed signs of leaking at radial cracks previous in existence. The fusible plugs were removed, marked front and rear, and impounded with the Depot Foreman. The boiler was then washed out in the usual manner, new fusible plugs applied, and the boiler boxed- up. The boiler was then filled up and subjected to a mains pressure test, 100 psi, the following was observed: the radial cracks at the top of the top row of flue tubes leaked a tear, four crown bolts in the first row leaked tears, all other parts proved tight.

I recommend the following: flue tubes be lightly rolled and beads at radial cracks be lightly tucked in by hand, the four crown bolts be lightly seal welded with the arc welder, and the engine returned to service. In my opinion the fusing of the plugs was due to insufficient water in the boiler.

... Boiler Inspector."

The above report is when the correct procedure is carried out by the enginemen: that is closing the regulator, if running, drop the fire, and close dampers.

Continued on page 46...

Peter Brotherhood and the Radial Steam Engine

by Don Payne and Dave Harper

Following the article by Don Payne on model radial steam engines, (AME No 51, Nov/Dec 1993), and the one on the radial powered circular saw (AME No 58, Jan/Feb 1995), I have exchanged letters with Don on the subject of Peter Brotherhood, inventor and patentee of the radial steam engine.

Between us we have dug up enough information on this prolific inventor and his radial steam engine to enable us to present to you this brief look at the subject.

Peter Brotherhood

Peter Brotherhood was born on 22 April 1838 at Maidenhead, Kent, England, the son of Rowland Brotherhood, a railway contractor. After four years' study of applied science at King's College, London and practical training at his father's works and in the Great Western Railway works at Swindon, he entered, at at twenty-one, the drawing office of Messrs. Maudsley, Son and Field, then at the height of their fame in the marine engineering field.

In 1867 he became a partner in the Compton Street Engine Works, Goswell Rd., London. The firm was mainly engaged in producing machines and engines of Brotherhood's invention. In 1872 he introduced the Brotherhood engine in which three single-acting cylinders are arranged at angles of 120° around a central chamber.

The engine can be used with steam, water or compressed air as the working medium. It was used with steam to drive early electric generators, with compressed air to power torpedoes and with water to drive capstans on docksides.

Brotherhood also did a great deal of development work on air compressors and built conventional compound high-speed steam engines.

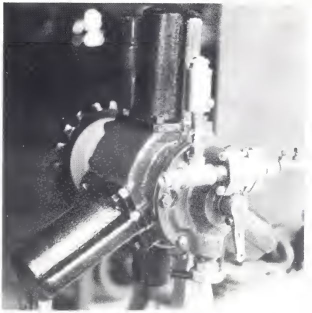
He was elected an associate member of the Institution of Civil Engineers on 5 May 1868 and a full member on 4 Feb 1879. He was elected a member of the Institution of Mechanical Engineers in 1874 and of the Iron and Steel Institute in 1877. He died at his residence, 15 Hyde Park Gardens, West London, on 13 Oct 1902.

This information came from the *National Dictionary of Biography* Jan 1901-Dec 1911 thanks to the State Library of NSW.

Sketches

Drawings of the Brotherhood radial engine appear in several books on steam engines, and seem notable for their variation! Several styles of valve gear are apparent in the drawings, so apparently various configurations were tried during the production life of these engines.

The drawings in Jamieson's *Elementary Manual of Steam and Steam Engines* (1906) (figs 1 and 2) show the piston valves and spherical big ends with auxiliary steam ports in the pistons. The exhaust ports in the cylinder walls must surely be one of the earliest examples of the uniflow principle? The design is dated 1873. A centrifugal governor in-line with the shaft operated the throttle. The author notes that many of these engines have been built not only for running dynamos and fans



but also for use with compressed air. As steam engines they are being entirely displaced by the double-acting high-speed engine. This would explain Brotherhood going over to producing conventional engines for the lucrative generator market.

In Dickinson's *A Short History of the Steam Engine* (1963), are figs 3 and 4 showing the first engine displayed in 1872.

Although the text states that steam is distributed by balanced piston valves actuated from the crank pin, the diagram shows more of a radial valve arrangement. We'd love to hear from anyone who could throw more light on this matter!

Dickinson goes on to state that the engine is made in many sizes from 2½" bore by 2" stroke, giving 1¼bhp at 1000rpm, up to 7" bore x 6" stroke, 55bhp at 500rpm.

Interestingly, in *A Short History of Naval and Marine Engineering* by E. C. Smith (1937) I found details of HMS *Waterwitch* built to the design of J. and M. W. Ruthven of Edinburgh in 1866. This was one of several experimental vessels built to try boat propulsion by centrifugal impeller and water jets.

Waterwitch was a gunboat 162ft long, 32ft beam and 1161 tons displacement. The power plant consisted of a three cylinder engine with an impeller mounted directly onto the crankshaft. Fig 5 shows the arrangement.

The impeller weighed 8 tons and revolved in a chamber of 19ft diameter. Water was drawn in through a large number of openings in the bottom of the hull and discharged through two nozzles 24" by 18" one on each side of the vessel, fitted just above the waterline. By sluice valves the water could be directed either ahead or astern.

With the engines giving 777 indicated horsepower 9.3 knots was achieved in calm water but only 5 to 6 knots in the open sea.

The mind boggles at the gyroscopic forces generated by an 8 ton impeller being tossed around in a rough sea! The whole system proved too inefficient and was abandoned. However, it does pre-date Brotherhood's patents, and one wonders if he was aware of these experiments. Being in the marine engineering business, it would seem highly likely.

Oz radial

Today the three cylinder radial steam engine lingers on in the form of the Smith friction steam engines built by E. W. Smith Engineering of Coffs Harbour, NSW between 1945 and 1950 (pictured).

About a thousand of these were produced to drive carrier rollers in sawmills. They had pistons based on the Model T Ford, a radial steam valve and a nominal bore of 3¾". They could be bored out to 4¼". They developed 10hp at 100psi.

This information was kindly sent to me by Don McKenzie of NSW, whose father worked in the timber industry in Eastern Dorrigo. I'm familiar with these engines because we have one in the QSVMS museum at Petrie where I spend much of my time! The photo shows our restored example which still runs on steaming days.

That's about all we know at this stage, we'd be glad to hear from anyone with any further information on Peter Brotherhood and his engines.

Numerous model radials have been made, but I doubt whether anyone has copied the spherical big end system. That would be quite a challenge! Any takers?

TONEYA

A 2½" scale Fowler Locomotive

by Ross Bishop-Wear — Part One

Photos by Ross Bishop-Wear except where noted. Drawings for publication by Neil Graham

***Toneya** simmers quietly between runs.*

Looking back over twenty years of completed projects, it is interesting to recall the circumstances and factors that guided my interests at the time. I guess there is a reason behind every project and the objectives often change over the duration of one's life.

Gaining experience

In my earlier work as a teenager, efforts predominantly went into merely making parts that fitted each other satisfactorily (sometimes taking several attempts), more so than focusing on achieving a specific result. By this I mean that projects sort of started small and straight forward increasing in complexity as my skills developed and I discovered new possibilities. Sometimes I'd just make something to try out a new technique. My models kind of evolved to a point of satisfaction rather than be purpose built from the outset.

This, in a sense, has allowed me to develop a broad experience of what works, what doesn't and what's practical and what's not. I find these days I can often evaluate the success of an idea without laboriously trying it out. The same with techniques of manufacture. Experience allows me to consider a variety of ways of tackling a job and see in my minds eye what troubles lie ahead. How to circumnavigate the limitations of equipment, personal inadequacies and overcome difficulties which had previously lead to compromise can, to a fair extent, be dealt with in the planning stages due to experience. In short, I feel confident about saying "this is what I want to make" and know the best method will soon come to mind and off I go 99% sure of the result.

So, in the light of experience, personal reward and satisfaction would come only from new and more demanding challenges. Churning engines out like sausages is no fun. *Toneya* would have to be my best work, made of the finest materials available and shortages of time, money or patience were not to detract from the finished product in any way. For me, it was time to concentrate all efforts on achieving a personal best, perhaps never to be repeated in my model making endeavours again.

I chose a two foot gauge prototype for several reasons. In five inch gauge (2½" scale) they are a great size. A large, easy to operate engine with all the advantages of five inch tracks. Scale parts can be made large enough to work reliably and yet they just look and feel right on the engine. To a person like me, who is not particularly good at microscopic bits, the fiddly stuff is more manageable and the pursuit of authenticity all the more possible.

Born 20 years too late?

I regret not living in an era of prestigious express trains hauled by steam but you can't choose your birthday. As much as I admire the big engines, I can't help my feelings for the engines I remember at the tail end of the steam era. That is, Tasmania in the late sixties, Newcastle coal traffic and narrow gauge coming off the cane fields and finding new homes in preservation. To each his own.

Under the Fowler spell

This particular 0-6-2 by John Fowler of Leeds, England has, for me, particularly pleasing features about it. From buffer to buffer, rail to roof, from wherever you stand, the aesthetics seem nicely balanced; visually satisfying. To see *Toneya* in action and watch the way it moves would be a timeless pleasure. The same might be said of its namesake! In spite of the locos perceived perfection, as I got to know the engine more intimately, flaws and inadequacies began to reveal themselves. Actually, this aspect of building a working model of particular prototype is one of the most enlightening parts of the whole project. To try and understand the thinking that went into the design and consider the production and marketing implications is often a real education in reality. Things often seem wonderful seen through the starry eyes of an enthusiast, However, with an opportunity to get beneath the superficial splendour you soon come to

realize that these machines, in spite of their universal fascination, were made by ordinary people working for an ordinary machinery manufacturer trying to earn a quid in a competitive market. There were sales options offered, patent gadgets of alleged superiority, outrageous claims of efficiency and reliability all of which we have learned to treat with scepticism in today's consumer society. John Fowler & Co., did, however, have a good reputation in the small engine market, evidenced by their huge output of traction engines, road building equipment, heavy haulage machinery and of course narrow gauge locomotives, rolling stock and associated hardware.

The Bundaberg Fowler

Of considerable value, have been the works drawings of the Bundaberg Fowler. My sincere gratitude to the person whom supplied them (he will know who he is). The Bundaberg engine was taken from the John Fowler design (under what arrangement I couldn't say) and built by Bundaberg Foundry in Queensland nearly twenty years later to modernized construction methods, namely more welding and less riveting, and other minor differences. However, dimensionally, it was the same. This information, coupled with a few photographs of *Airdmillan*, a genuine riveted John Fowler version stored in disrepair at the Australian Narrow Gauge Railway Museum at Woodford near Brisbane seemed adequate for me to make a reasonably good representation of these engines. Further inquiries, if people are interested, can be made to the Reading University Museum of English Rural Life. Many John Fowler drawings, photographs and catalogues are available from this source for those who are so inclined.

In my case, I reserved my right to make alterations and additions as I pleased because this was not meant to be a perfect copy, this was to be my idea of the perfect engine while adhering closely to the external appearance and adopting many of the features due to the appeal explained earlier. Other minor additions and changes were allowed to incorporate things I particularly liked on engines from the narrow gauge scene.

Getting started

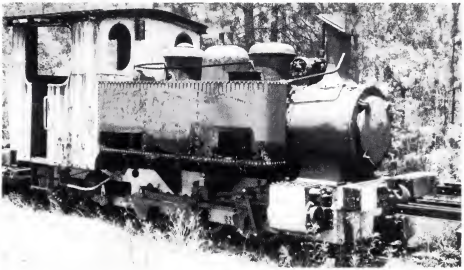
Well, being sick of hearing about people and their frames I figured I'd start somewhere else! Why not build the mechanical lubricator first? You could hang it from the ceiling at just the right height and keep adding bits until it touched the rails. Well, I did that and it's not very practical! So I carefully packed the lubricator away where it would remain for nearly six more years before it was needed. The boiler captured my attention instead.

Briggs boilers

A lot of bad vibes and misinformation surround Briggs boilers. I have made five engines with this type of boiler so I feel I can make educated comment regarding them. As installed on most miniatures they are generally poorly disguised. The visible welding and discoloured paintwork around the back end is a dead give away. Ugly too! I chose to use a Briggs boiler, firstly to demonstrate that they can be made to look as good, actually more realistic around the backhead than a copper one, to gain the advantage of extra adhesive weight and slow down the thermal fluctuations due to the large mass of metal involved. This produces a more realistic engine to drive because, like a real one, you've got to get it hot well before you need it or you'll wonder where the steam's going. Also if you want to sit on a siding and talk for a while, its no problem to walk away for an hour or so because it'll just sit there with the needle glued on 80 pound for ages!

Just briefly I'd like to try and tackle the popular misconceptions of Briggs boilers as I see them. Perhaps discussion may follow through the pages of AME's Letterbox.

- They don't steam
  Answer: Wrong!
  Used on suitable prototypes they have all the steam you want and more. They are not suitable for narrow firebox types, long skinny boilers needing large tubes (thereby limiting the number) and combustion chambers or small models say under 150mm outside diameter barrel. They work well on narrow gauge, where boilers are short, fat and generously proportioned.
- They are very inefficient.
  Answer: Maybe.
  Certainly more heat is lost around the firebox due to radiation in the average installation. One of my challenges has been to insulate this area more effectively so presumably now the heat that is normally lost to the surrounding air is just sent on down the boiler tubes with the rest of it. Perhaps the gas temperature leaving the tubes is higher than that in a conventional locomotive type boiler, I don't know. There is no evidence that this is very serious because the paint doesn't burn off the smokebox. One would think that if the tubes were the correct size for their length and all the heat was directed down them (rather than lost through inadequate firebox insulation) then the same amount of heat would be required to meet the same steam demands regardless of the type of boiler. I have not found steaming or coal consumption to be to any sort of detriment.
- They are easier to make than copper boilers.
  Answer: Doubtful.
  If anything, in the smaller sizes they are harder to make due to the difficulty of performing pressure quality welds in tight conditions and on small parts which are inclined to overheat. However, getting things straight and square after all that welding is very hit and miss and not easy to correct like a copper boiler. There is certainly a lot more work in making a decent job of installing the thing in an engine so that it looks okay. Don't make your decision hoping to find a shortcut here because you will be disappointed.
- You have to have a pressure ticket to weld them.
  Answer: Not so.
  Under AMBSC you may weld it yourself if you want. *But,* you must do it under the supervision of a certified welder. It's not easy so you'd want be good at wielding a stick before you try. The best way is to enrol in your nearest technical college to do a post trade certification and ask the teachers (who are generally highly qualified and practical) to guide you and supervise what you do. I did this for mine and learnt a great deal about welding skills at the same time.
- Steel boilers corrode
  Answer: Not with proper care.
  Unlike a boiler in commercial operation,



Decayed remains of a prototype in the Australian Narrow Gauge Railway Museum at Woodford in Queensland.

our boilers spend the great majority of their time stored between runs. It follows then that corrosion prevention should be directed towards proper storage more so than while it's in steam. I always leave them dry having blown down at ten or twenty pounds at the most and opened them up by removing plugs from the back, front, top and leaving the blowdown open so the ambient air is free to flow around and condensation due to sweating cannot occur. An additional and very effective way of ensuring no condensation occurs is to run a low voltage (for safety) light globe in the firebox or water space to elevate the ambient temperature in the boiler a degree or two and promote convecting air currents through the boiler. My father has done this for years and his Perry boiler is immaculate inside after more than ten years of service.

- You need water treatment
  Answer: Yes and No.
  Local water supplies vary greatly. I'm not a chemist so I can't make scientific comment about water treatment. My feeling is that if you need to use a water softener or descaler in your boilers then you should use it equally in copper ones as much as steel. Remember your boilers spend 2% of the year boiling water and 98% resting. What a life! Look after your boilers while they sleep. Dry and ventilated is a proven winner for me.

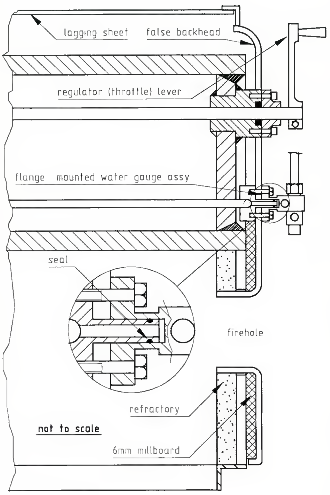


Figure 1 BACKHEAD SECTION

Wet boiler and dry bum

The feed water is all carried in the driving truck as previously described in a three part series titled *Ground Level Driving Truck* (previously published in AME commencing Sept 1991).

Of cabs and boiler backheads

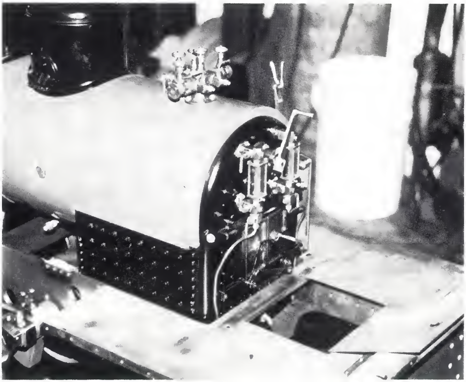
If any one part of a model is my favourite it's in the cab. I like to have it easy to operate and have the controls look and feel like the real thing. Where I'm inclined to skirt other perceived essentials (like superheat) I put my efforts into the cab. *Toneya* was to be state of the art. So, many hours went in on the backhead. The backhead you see is a total facade of course, the ugly bits hidden underneath, but this allowed me to include scale plate thicknesses, riveted seams, scale stays all round the firebox, washout plugs and finish the lagging just like a proper boiler. Underneath the footplate; foundation ring rivets, corner washout plugs and a scale blowdown cock complete with a line scored across the square to show that it's shut. Too bad nobody can see any of it now!

Well, once you start making scale fittings you just can't cut corners. So you can see the turret has stud mounted 180 degree globe valves (all fabricated bodies in phosphor bronze with stainless steel spindles) and the water gauges are the proper thing (about 30% over scale) complete with cut glass protectors that lift off just like for real.

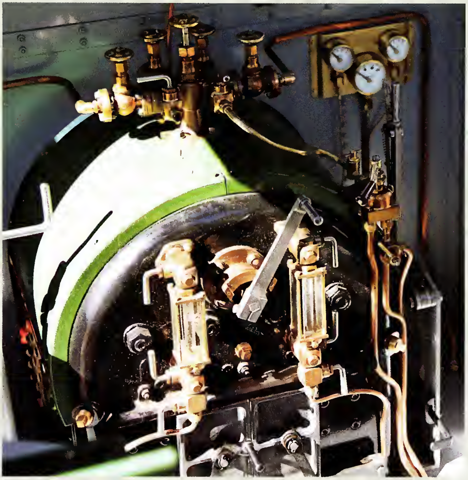
When I rang the local glass company and said, "I want to cut some very small windows. Eleven millimeters by forty two millimeters."

They said, "Don't you mean centimeters?"

"No I mean *really* small windows!" Anyway, I went up there and they gave me a diamond glass scriber thing and a table in the corner and after a while I got some to break



Left *shows another backhead view during construction. The hole in the floor allows access to the swing link bogie, usually covered by the shown flap. The nozzle of the scale blowdown is just visible below the floor. Note the scale boiler stays, rivets and washout plugs.*



A view into the cab showing backhead detail as seen through the removable bunker section.

Closeup of the steam turret showing the flange mounted globe valves.

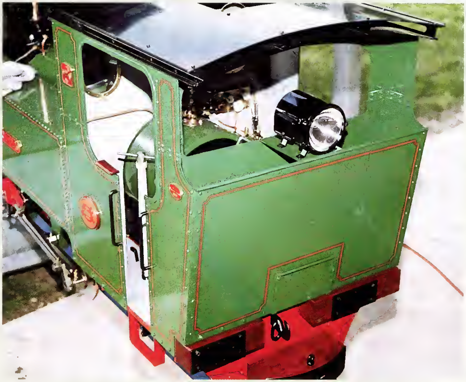
off at the right size! I probably should have used Lexan (clear polycarbonate) but I'm not sure how the expansion would go when it heated up.

Additions in the cab include a little valve below the brake application valve that allows you to select either the steam brake for the engine or vacuum for the train. The gauges on the front right wall of the cab show these two functions and also the steam chest pressure which I wanted to measure for the purpose of analyzing the effect of balancing the slide valves (to be discussed later).

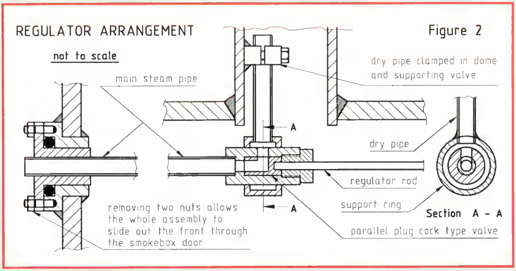
The folding driver's seat I'm not sure belongs to Fowler engines but they are common among our sugar cane engines and I just had to have one! The cab rear by necessity is cut out to facilitate driving and firing but when the removable section is installed, complete with aft shining headlight and the bunker topped up with scale coal, the only clue is the joint in the bunker plate at the back.

So, I kept on with the boiler until it was entirely complete, painted and steam tested. At least now I could put it in the bedroom for inspiration! Actually *Toneya* remained just a boiler for some time now having become committed to another project followed closely by moving to temporary accommodation while we had a house built. Ah, the monotonous humdrum of life plays hell with your dreams doesn't it?

Barry Potter (the master Blowfly trainer) once gave me the best possible advice. "No matter how busy you are, do something for yourself everyday." I thought that was the most sensible thing I'd heard in a long time. So, bit by bit, pieces of *Toneya*, ideas, sketches and materials gradually accumulated. The diagram in Figure 1 shows the arrangement of the false backhead and the way the fittings are mounted. It is common with small Briggs boilers to experience bubbling in the water gauges, particularly when working hard, so in accordance with experiments by others in this regard, I resolved to run largish pipes from the water gauges out along the barrel to connect with the boiler just ahead of the back tube plate; under the rear sand dome in actual fact. This arrangement is only partially successful. Although I'm confident an adequate reading of water level is given there are still odd bursts of bubbling (usually only in one or the other) and an inexplicable tendency to



With the removable bunker plate and light in place, the joint is nearly invisible.



show a higher level in one glass than the other. Mostly these things are rectified (at least temporarily) by blowing the gauge down.

The firebox

The false backhead is insulated from the dry firebox walls by a 6mm thick layer of Millboard (used to be asbestos but not anymore). On the fire side of the dry walls is an insulating cement. Refractories and cements of this type are becoming hard to get these days due to the disappearance of conventional steam boilers in industry. However, in the course of hunting for a suitable material I learned some interesting facts.

There are basically two types of materials having two completely different functions. Refractories are concrete like materials capable of withstanding high temperatures and direct flame. Their primary function is for use in furnace walls, arches and barriers in the fire's path. Their insulating properties are secondary and actually, they're not that good.

The second product is an actual insulator designed to be batched like mortar and smeared onto pipes, joints and other areas difficult to insulate by other means. The thing is that the better the insulator the lesser the ability to withstand direct contact with the fire and vica versa.

So, you are faced with finding middle ground. The one I originally used is called Stictite® and in concert with the millboard the insulation is adequate because the paint has not burned off the outer firebox. However, after just over twelve months it has failed, due to the abrasive nature of the firebed.

The front view illustrating dual buffing gear, headlight and turbo-generator.

Photo: G.R. Kirkby

A new lining has been made from castable refractory — product number 1375M (its good for 1375° C), made by Bulli Refractories Pty Ltd. They live about 70 kms south of Sydney (just north of Wollongong). This product has been painted on the fire side with a 1mm facing of Air Dry Mortar, which resulted in a hard and abrasive resistant concrete like surface. Time will tell if this is the answer — although it looks far superior to the original material.

More experimentation

Another area of experimentation was with the throttle. The use of teflon ball cocks for throttles has been well proven for many years. However, to install one inside the dome and still have authentic control movement in the cab would have meant some tricky assembly work in a virtually inaccessible place. I therefore decided to try something new as shown in Figure 2.

The dry pipe is fixed in the dome. This provides vertical support for the throttle and ducts dry steam in from the top. To remove the throttle it is only a matter of removing the handle in the cab, two nuts from in the smokebox and out it slides. Not much different to the old disc and tube type except, being cylindrical rather than a circular disc the physical size of the valve is quite small for the size of the opening achieved.

To take a leaf from the book of ball cock practice, I fitted a teflon sleeve for the stainless bobbin to turn in. This gave a silky smooth feel and absolute tightness of seal. At 200 psi hydraulic, not a drip. In steam, the teflon expanded so much that the throttle couldn't be moved. After easing the fit to 2 thou clearance cold, it worked very nicely. But, after half a dozen runs, the teflon sleeve came loose and rotated in the valve body covering the port completely and ending the experiment.

The teflon sleeve was replaced with a phosphor bronze one having about half a thou clearance on the stainless bobbin which seems okay at the moment. Only time will tell if it continues to work satisfactorily or whether it leaks, scores or seizes up altogether. The

teflon experience was a disappointment because I'd heard other notable builders expound on its virtues. There were other areas where I tried it and failed again. With hindsight, I wouldn't be tempted to use it again due to the high rate of expansion and the difficulty in integrating it into a mechanism because of its soft, weak state when hot.

The superheated question

I figured I wouldn't bother with superheat; the prototypes weren't. An engine this size will pull anything I want to pull on thirty pound. Also, my fathers *Perry*, (which I built), a similar engine in size and boiler configuration has given no problems in the steam department. So why would I want to clutter the smokebox with plumbing just to gain a few measly kilojoules as shown in the table above?

EXTRACT from STEAM TABLES (figures rounded off)				
Gauge Pressure	Temp. in Deg. C	Heat Energy in Kilojoules / kilogram		
		h (water)	Latent Heat	H (steam)
Saturated Steam				
6 bar	158	700	2070	**2770**
Superheated Steam				
6 bar	178	N/A	N/A	**2810**
The above example shown with 20 degrees of Superheat				

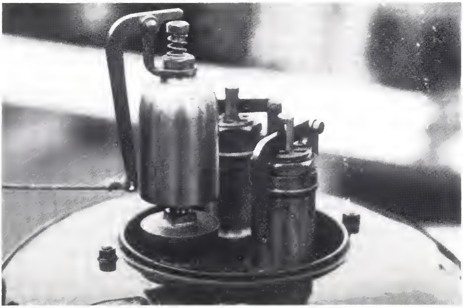
Well, now that its too late to do anything I wish I had. It's just that an engine this big takes a while to heat up and until it does, its got a lot of water to deal with. What I'm finding is that starting to work up a hill after ambling along on a small throttle setting you need to open the drain cocks for a while to clear the condensate. To make matters worse, the particular arrangement of the steam pipes coming in the back of the cylinder casting and up into the steam chest provides a low space (virtually a trap) in which the water can collect. When you open the throttle suddenly, the collected water surges through and up the spout. It's not as bad as it sounds and with use of the drain cocks it's quite okay, but I think it could have been much improved with superheat. If anyone says to me; "I told you so" ... watch out!

Buffer beam

The photograph showing the front of the engine illustrates the offset buffing gear for use with 3' 6" wagons. I do not know the exact circumstances behind the need for this but it adds an interesting touch to the otherwise plain face of the buffer beam. The timber used for the blocks is Western Australian Jarrah. It is a very hard and stable timber with beautiful red grain that really comes to life with a simple coat of clear. So impressive was it that I used it behind the pressure gauge, behind the builders plates, for arm rests, the driver's seat and the steam brake handle as well.

Electrons on tap!

The turbine generator works well on six volts being made for me by a friend with particular talent for electricity. I shan't mention his name in case his phone starts ringing off the wall but his efforts are appreciated as a valuable contribution to the model. Cab and headlights are switched from Tandy switches in the cab being wired through the terminal box on the cab front like for real. I couldn't find a suitable metal reflector for the headlights (they are mostly plastic these days with a horrible pattern in them) so I bit the bullet and made a deep drawing die to press them out in stainless steel. The result is excellent as I seemed to fluke the right curvature and all. The only problem is seeing past the exhaust steam from the generator as you slip through the night!



Safety valves with levers for easing and a genuine John Fowler whistle.
Photo: G.R. Kirkby

Lighting up

The little valve on the right side of the smokebox is an RBW addition for controlling the draft during lighting up. An air fitting is provided underneath to connect a hose so that draft is created through the engine's own blower nozzle until steam is raised. When you're ready, you just shut this valve and open the steam valve in the cab and the transition is complete. You can then remove the air line from underneath at your leisure, and you'd better not forget!

Domes

I get a lot of compliments for the domes which is nice, but domes, especially painted ones, are not hard to make. They started out as rusty pieces of 1/16" wall thickness x 5" diameter Electric Resistance Welded tube and were beaten out into a female former made of heavy wall pipe suitably shaped at the bottom. The former took some time to shape properly with the oxy and grinder but the actual beating part was nothing. Steel is very easy to work in this fashion because it retains is shape so much better than annealed copper. You know, with copper, it's so soft it's so easily scratched and dented; with steel you just whack into it and where you hit it moves and the rest just holds its shape. The tops of the sand domes were machined from solid plate because they just sit on the end of the tube all secured by screwing the sandbox lid onto a stud mounted on the boiler barrel. Dummy sanding gear adds the final touch. The steam dome top is also machined from solid plate and it is silver soldered into the tube with the join carefully finished smooth. After painting you can't see any evidence of a joint.

The rest of the work around the top end consisted of laser cutting the cab and tanks from 1.6mm zinc anneal sheet and riveting it all up. The windows on the cab front are properly glazed and open by means of a little catch and centre pin hinges. The double thickness roof was a feature of sunny climes and adds quite some to the narrow gauge character. Number 8 signifies the eighth engine I've completed and not any particular sugar mill numbering system.

Part two will conclude this article with some interesting discoveries among the frames and motion, and, we will have another look at the boiler.

Stay tuned...

Adding a Clutch to a Geared Head Lathe

by Peter Dawes

Drawings for publication by Rex Swensen, photos by the author

This article refers specifically to a 6" Taiwanese lathe labelled the Hafco AL960B sold by Hare and Forbes of Parramatta, but no doubt it could be adapted to any geared head lathe. Adding a clutch is the primary object here but a number of minor specific modifications to this lathe are also included in the second part of this article.

The problem

This lathe suffers from the serious inconvenience that it is necessary to switch off the big 11 amp (1.5 HP) motor just to stop the headstock even for a few seconds to take a measurement. It is also necessary when changing gears. The convenience of the geared head is partly sacrificed by having to turn the motor off and on, unlike a belt-driven lathe.

Workshop power supply

Although the motor is rated at about 20 starts per hour, turning off the power is not the whole point. It is extremely bad form to have an 11 amp, highly inductive load switched on and off frequently in a domestic environment. The workshop should in any case be wired with a special line from the switchboard wherever there are machines with loadings as large as this. For example, mill/drills at 13 amps, welders 12-15 amps, lathes at 11 amps, etc. That line should ideally be a different phase from the others in the house.

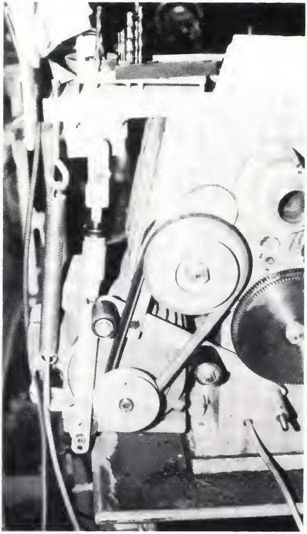
The switch-on current of an 11 amp inductive device probably exceeds 50 amps for a few milliseconds so it will cause big drops in the voltage to any other devices on the same line for that length of time. It also radiates strongly at radio frequencies (RF) so devices such as computers which are sensitive to both voltage drops and RF, are very vulnerable. If you have a computer a separate line is essential. An Uninterruptable Power Supply (UPS) would be desirable too in such a case.

Using belt drives as clutches

Belt drive lathes such as the Myford and the 9" swing Hercus/Southbend/Sheraton can be disengaged by simply releasing the belt tensioning lever. Belts provide slip to take up the load, they don't have faces to wear, are easy to replace. In fact they make an ideal clutch.

This then is the basis of the mechanism to be described here. In the AL960B lathe the primary drive is a two-speed, single sheave B-section belt. Some lathes have two A-section sheaves with a single speed, but the principle is the same — that of exploiting the belt part of the drive.

Note 1: That the raising blocks (described later) are necessary for the clutching device with this lathe unless your lathe has been designed to give more clearance at the back between the motor and tray than mine. I might add that a new one I saw quite recently still suffered from this same annoying defect.



Headstock end view of the lathe.
***Note**: the raising foot under the foot, the bar on its stud, the secondary link and the spring bracket.*

Note 2: The two-speed pulleys on my machine are to coin a word, not parcentric, ie. they do not give the same centre distance on the two speeds. It is a matter of ⅜" difference. Because I never want to run it at the fast ratio anyway, I am happy to leave it on the slow speed ratio all the time. The only thing the fast ratio gives is 1400 RPM and this lathe is not intended for sustained work at that sort of speed, being somewhat noisy and tending to vibrate.

It is not rated a production machine for high speed work with carbide tipped tools. However for the workshopper it is a very cost-effective machine. It is nevertheless inferior design not to make the pulleys parcentric, and it just means more inconvenience for the operator, with or without the clutch mechanism. So to change pulley speeds still requires a change of hole on the lifting arm (see details later) at the motor mount bolt, or adjustment of the toggle, or both, but once adjusted at either speed the clutch works the same, is fully effective, and is in no way compromised. However, the clutch is still a big improvement over not having it.

The real solution of course is to fix the pulleys. Can this be done? The slow ratio is the tighter one, so this is the one that should be relaxed to make them equal. But the small motor pulley is only about 2" PCD and this is as small as one should go on B-section. Therefore, the diameter of the large driven pulley would have to be reduced. Unfortunately this raises the lowest speed of the machine and that isn't desirable either.

My rough calculations show that if d1 is the change in diameter of a pulley, the centre distance changes in the ratio of ¾ x d1. So it would mean an unacceptable change in ratio. Making new pulleys would be horrendously difficult, even if it were possible to get a pair of castings the right size. You would almost certainly have to design them yourself, make the patterns, have them cast, and then do all the machining. This is possible but hardly practical. Then the bore of the driven pulley is 17 mm !! and it has a ? ¼" wide keyway in it.

It looks as though I will be living with the pulleys as they are!

Clutch Mechanism

I will be using Imperial measurements here predominantly because most of my stock is still Imperial and because most of the screw threads on lathe are Imperial. A few measurements will be given in metric for a specific reason.

The weight of the motor is taken by a heavy tension spring, which, when the clutch is disengaged, takes the tension off the drive belt(s). When the drive is engaged, the lever

lowers the motor positively, independently of its weight, although that helps, thereby tightening the belt. It is locked automatically in the engaged position by the knee-like action of the "lifting arm" and importantly, the locking action is then maintained by the spring. So the spring is quite essential.

Unfortunately, a belt won't necessarily slip just because the tension is taken off it. To use the slipping belt as a clutch it is absolutely essential to force the belt into a loop that takes it clear of one or both sheaves. This is done with a pair of ball-bearing rollers, one placed on each side of the belt. The device could be dangerous without this feature because the headstock could start to creep. Do not attempt to build the clutch without the rollers.

Positioning the rollers

With a single speed pulley system the position of the rollers is not critical — almost anywhere along the middle third between the two pulleys will usually suffice. However, test the operation before fixing the rollers. They are placed just outside the line of the belt when it is tight so that they do not make contact when the clutch is engaged.

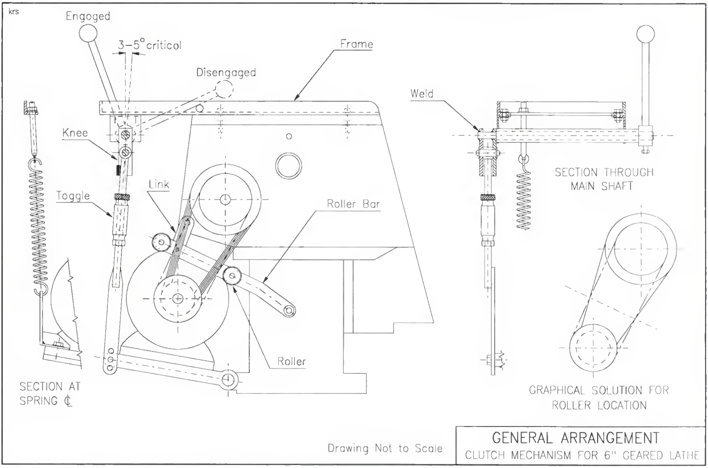
With two-speed sheaves however, positioning the rollers is quite tricky. Notwithstanding that they are not parcentric, it is still necessary to treat them as two-speed pulleys. The error in the calculations is small enough not to affect the placing of the rollers. The essence of the problem is to find a place to put the rollers so they will have exactly the same effect whichever sheave is in use. Obviously we don't want to have to adjust them for every change of speed. There is only a limited range of contact positions that work properly for both speeds.

At this stage I went on a fascinating diversion to calculate the position mathematically on the computer, assuming "parcentricity". It proved to be quite a challenge, requiring the solution of two cumbersome simultaneous equations. The easiest way then was to solve these by iteration, but in fact a clever theoretical method without any calculus was devised by Dr Martijn de Sterke, physicist at SU.

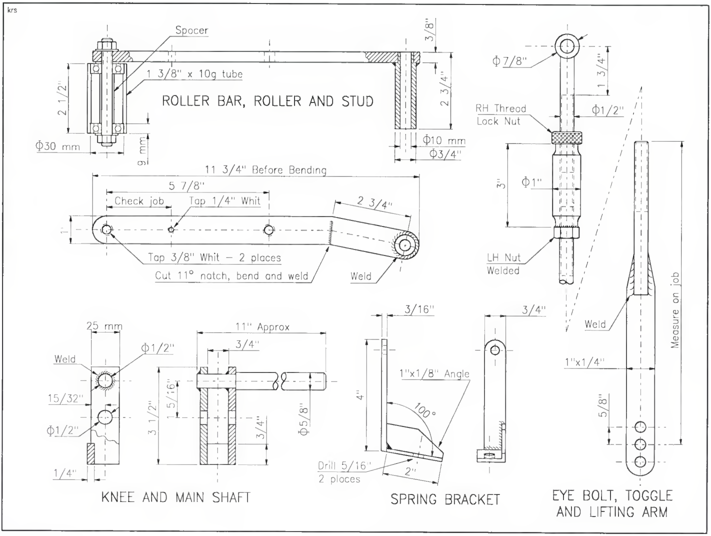
You can determine the position by reasonably simple graphical means for your own lathe, should it be different from this one. Lay out the drive on a large piece of paper. Draw the outside diameters of all the pulleys, ie. over the belts, at the correct distance(s) apart and superimpose all the lines representing the back of the belt between the two pulleys for both speeds. Where the lines cross on each side is the position for the roller rim to make contact with the belt. Add about 3⁄16" extra spacing per side to provide some clearance. On my machine, the two pulleys are at 8.125" centres when the belt is tight on slow speed. The motor sheaves are 2.5" and 3.5" diameter measured over the belt - not on pitch circle! The headstock pulleys are approximately 5¼" and 3⅞" respectively . With these sizes, the rollers should be located on a line 3⅜" offset from the motor shaft centre. I suggest that you can use this design without any recalculation unless your drive is a quite different one.

Both rollers are supported on a single specially curved bar made of 1"x ⅜" steel (the roller bar) that bolts conveniently onto the end of the headstock body. The front, lower end of the bar is held on the lower of the studs that hold the large aluminium gear cover. The curve in the bar is required to steer the bar in a direction that takes it at the correct distance between pulley centres and on a line that is exactly at right angles to the line joining the two shafts. That ensures the rollers will be symmetrically placed on the two sides. The upper, back end of the bar is held by a short secondary link about 4" long that bolts to the body of the lathe using the hole originally used for the tensioning strap, and then down to the bar with a ¼W bolt.

On my lathe the roller centres come out at 5⅞" apart, meaning that the actual roller faces are 4⅞" apart after allowing 3⁄16" on each side for clearance. Whatever your design, ensure that they are just outside the belt line for both speeds when the belts are tight. Allowing too much clearance means the belt has to be slackened excessively to make it loop free of the sheaves, and this could result in creep. Too little, and the rollers will be contacting the belt intermittently during driving. With ball-bearing rollers that isn't necessarily bad. The design figures allow plenty of latitude and there will be no problem due to minor variations, such as the belt, with other Hafco AL960B's.



GENERAL ARRANGEMENT
CLUTCH MECHANISM FOR 6" GEARED LATHE



The rollers

The rollers are made from 1⅜OD x 10G steel tube bored out to take common low-cost, double-side sealed ball bearings type 6200. These are 30mm OD x 9mm ID x 9mm thick. Put one bearing at each end of a piece of tube 2" long (or wide enough to span the belt(s) in all positions plus a margin) and make a tubular steel spacer to go inside between the inner races to space the bearings apart.

The roller bar

This is 11.75" long made of 1"x ⅜" stock. Round both ends. Drill a 9⁄16" hole at the bottom end for a spacer tube. Make a spacer tube ¾"OD x 2¾" long, and drill it out to 10mm ID or clearance, (a running fit) for the bottom stud. This tube is shouldered for a distance equal to the thickness of the bar and to a diameter of 9⁄16". This locates it for later welding into the bottom hole in the bar. But first put the bend in the bar. The bend is 11 degrees. It starts 2¾" from the bottom hole centre, where you cut an 11 degree wedge out of the bar almost to its opposite side. Bend the bar by 11 degrees. Check it roughly in place before welding the cut closed again.

Now weld the spacer tube into the bar oriented so that with the bend convex up, the spacer tube sticks out to the front. Make another 1" OD spacer 3/4" thick to go over the stud under the bar. This is needed because the foot casting of the lathe is recessed relative to the upper body and the bar must pass between the inner side of the belt and pulley, and the front end-bell of the motor, a relatively small space to manoeuvre in. Do not drill the upper mounting hole in the bar now because it it better to drill it off the hole in the secondary link which lies outside the bar when they are in place. The secondary link is a piece of 1"x ¼" (or metric) flat 4" long drilled at the upper end for the bolt that fastens it to the headstock (5⁄16"?), and 2⅜" away, it is drilled ¼" for the bolt to fasten it to the bar.

Try the bar in place and if OK mark the holes for secondary link and the roller studs, so they are at the calculated distances apart and have 3⁄16" clearance from the tightened belt. Take it off and drill the stud holes 5⁄16" for tapping ⅜W, and the secondary link hole #9 for tapping ¼W. (There is not enough room behind for a nut!)

The roller studs are cut long enough for the rollers plus front and back locknuts. If the belt has to be close to the end of a roller for any reason, put a fixed 3" diameter flange with a bevelled rim at the end of the roller to stop the belt possibly coming off when the clutch is disengaged.

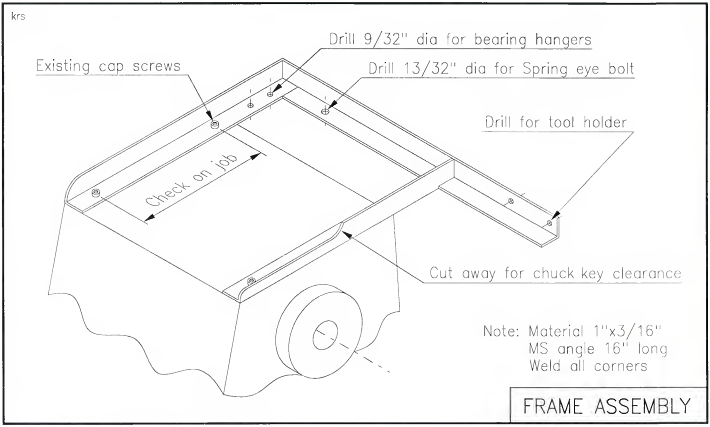
I also put ⅜" thick spacers on the roller studs. These are threaded and can act as lock nuts. If left out, the roller must be made an extra ⅜" longer. It was because of the spacers I had to put the 3" flange behind the roller as the belt is then very close to the end of the roller. Maybe a better length would be ¼".

The frame

The frame that carries the whole device is made from three pieces of 1"x 1" x 3⁄16" angle 16" long, two of which are bolted onto the sides of the top of the headstock. Place them in position and mark and drill holes corresponding to the existing ¼" capscrew holes that fasten down the top cover of the gearcase. The existing screws may still suffice. My holes were spaced 8⅜" wide by 9⅜".

The piece that goes on the right side should be cut down at the front for a length of 4 inches to a height of ⅝" so that there is extra clearance to operate the chuck key. Round off the ends of this thinner portion. The back ends of these angle pieces are joined by welding them to the third piece of angle.

The extra length extends to the right where it supports a very useful wooden tool rack, drilled and varnished, to hold small lathe tools such as the chuck keys, centre drills, centre punch, countersinks, lathe centres, Allen keys, etc. (See photos). The block is hardwood 12"



long by 3" deep and 1½" thick. It has a sloping front.

Drill it for the various tools, some holes right through but others such as for centre drills part way, then sand and varnish it. I also bolted a piece of ¼" hardboard a foot square, vertically to the cross-piece angle behind the headstock. With a couple of bull-dog clips this makes a good clipboard to hold charts and drawings.

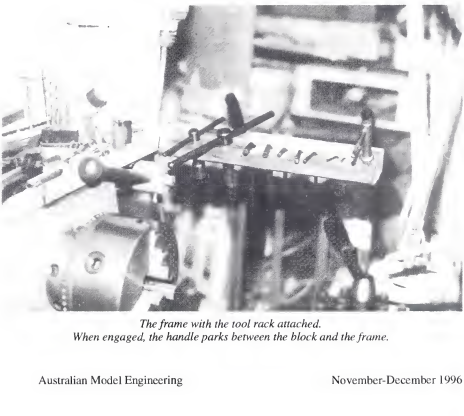
The open space enclosed by the frame behind the back of the top of the headstock is closed off by a piece of hardboard to extend the area of the work-tray on the top.

The frame also carries the mainshaft 1½" underneath, suspended on brackets. The mainshaft carries the operating handle which moves backwards and forwards to engage and disengage the clutch, in an arc of about 90 degrees. The limits to the motion of the handle are the locked extended position of the lifting arm when engaged, and either the motor contacting part of the lathe body, or whatever position it "floats" at, in the disengaged position. Perhaps a stop screw should be put in the frame to bear on the back of the stop piece of the knee when the clutch is disengaged. I did not include this in mine.

The handle is made of an 8 inch length of ½" steel with a round plastic knob on its free end and screwed into a large boss at the other. In fact, I borrowed my handle from the mill/drill where it was originally one of the three capstan arms, which I no longer use. The boss is locked onto the mainshaft with a ¼" setscrew. The handle must be positioned just to the right of the body of the headstock. Over the headstock and it would not have enough travel and would also come down on top of the parts on the tray. Too far to the right and it would be over the chuck or over the work — equally undesirable. The ideal place is over the camlock body.

The left end of this mainshaft is welded to the knee of the lifting arm which does the locking. Our own knees lock in the straight position by an identical physical mechanism. It means that we can stand straight upright with the expenditure of very little muscular energy. The bottom end of the lifting arm is attached to the motor mounting plate at its pulley end in the same hole used for the stay that tensioned the motor originally.

A heavy, stock, coil, tension spring 1"OD x 9" long wound with ⅛" wire takes the weight of the motor and hence the tension off the belt. My spring luckily happened to be plated. It came from a hardware store's "spring bar" but motor and caravan parts suppliers may also have them. Spring tension is adjusted by a nut on a big ⅜W nickel-plated screw-eye forming its upper attachment to the frame. Counter-balancing is not critical. The tensioning of the belt when the clutch is en-



The frame with the tool rack attached.
When engaged, the handle parks between the block and the frame.

gaged is a positive force from the lifting arm and then the knee locks it in position.

Belt tension in the locked position is adjusted by a telescoping nut in-line in the lifting arm (the toggle). Belt tensioning actually takes place against spring tension, so in fact, spring tension performs an important double duty by holding the knee firmly locked in one position and supporting the motor weight in the other.

The toggle

Make this out of BMS 1" diameter by 3" long. Drill and tap one end to the halfway point ½ (threadtype is not critical). The other end must be tapped with a left hand tap of similar size and pitch. It is desirable however, to choose two threads of the same or nearly equal pitch so that they will screw in and out by the same amount at each end. If you cannot get a left handed tap or nut of the same type as the RH one, the two closest matching pitches are Whit (12tpi) and UNC (13). The next best would be BSF (16) and UNF (20).

Perhaps this LH screw is the only really difficult aspect of the whole job if we exclude the lifting of the lathe with a hoist. An alternative to a tap is to get hold of a ½" LH nut and carefully weld this onto the end of the toggle so that it is properly in line. If it is not in line, the toggle will bind.

NB: If you use the nut you must remember to drill out this half of the toggle to the **clear**ance diameter of whatever screw you are using before welding the nut on. Nominally, that will be 17/32" or 33/64".

The matching screw thread for the LH screw-hole is simply cut in the lathe from ½" round BMS. The outside of the toggle can be knurled and/or flats can be filed for a spanner. A simple ⅜" thick by 1" diameter knurled locknut is fitted to the RH screw part to lock the toggle and prevent unwinding due to vibration.

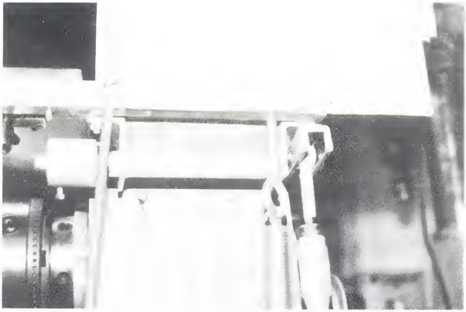
The lifting arm

The lifting arm when in place and locked lies very nearly vertically. It is formed from:

- the knee joint at the top end;
- the upper screw, the top end of which is in the form of an eye-bolt;
- the toggle, joining the left and right handed screws together;
- a 1" x ¼" strap at the lower end, to which the other ½" screw is welded.
  The bottom end of the strap is drilled with three 5/16" holes on ⅝" centres to provide an adjustable attachment for the capscrew that fastens it to the corner of the motor mount. The strap has to pass very close to the front end of the motor and to the rear of the motor shaft, which is why it must be a flat and not a round.

The mainshaft

This is a piece of ⅝" BMS (11" long for my headstock). The left end is turned down for a distance of 1¼" to a diameter of ½" forming a shoulder that helps position the



The back view under the frame. Note that the knee is bent here if the clutch is disengaged.

knee piece later for welding. The mainshaft rotates in a simple tube 7½" long of ⅝" bore fitted with brackets welded on at each end so that it can be bolted up under the frame with ¼" hexagon bolts. It doesn't require any special bushing unless they are needed to obtain the ⅝"ID. Probably the easiest way to make it is to use a piece of 1" x 16G tube and bush it with stock bronze bushes ⅞"x ⅝". The brackets are two pieces of 2 x 2.5"x ⅛" angle drilled 1" diameter close to an edge for the tube and welded or brazed or silver soldered to the tube. The tube should be filled with GP grease before final assembly.

The knee

In position, this fits flush under the back left corner of the frame. Make it as per the drawing. The critical thing to watch is the position of the "stop". This must be located carefully so that in the locked position the "leg" goes just 3 to 5 degrees past 180 degrees, ie. beyond a straight line. Whereas in the bent position it must be able to flex at least 100 degrees. The eye at the top end of the upper screw is made of a piece of ⅞" diameter BMS. Drill it ½" for the knee pin and part it off at a thickness of just under 3/4". Weld it onto the end of the top screwed rod which must have an unthreaded portion about 1⅝" long, because this part contacts the inside face of the "stop piece".

The side pieces of the knee are formed of two pieces of steel flat stock 25mm x 6mm x 3.5" long. Clamp them together and drill them ½" at the mainshaft end. Put a temporary ½" pin in that hole and then drill the knee pin hole centred 1 & 5/16" from the first hole and 15/32" away from the edge that will later be welded to the stop piece. That is, it is almost but not quite, in the exact centre. The stop piece is 1¼" x ¼" x ¾" long. Mill rebates along its two sides to a depth of ⅛" so that the central land is ¾" wide.

Make a jig to clamp the side pieces in the rebates of the stop piece and put temporary close fitting pins in the knee pin hole and mainshaft hole to ensure they remain lined up during welding. Then weld the stop piece to the side pieces. If you haven't yet made the eye bolt, make it now. Fit the eye bolt with a temporary pin and test the action of the knee both fully bent and locking. It should lock at between 3 and 5 degrees past the straight. If it doesn't, add metal or remove metal from the shank of the round bolt or from the inside surface of the stop piece, or both, until it is right.

Then weld the knee to the mainshaft by welding both side pieces onto the ½" diameter turned-down portion. The knee pin is a piece of ½" BMS 17/16" long pinned or fitted with circlips at each end to hold it in place. Alternatively you can drill each end of the pin axially and tap for 3/16" round head screws. A washer at least ⅝" diameter under each screw will stop the pin drifting out.

The throw of the knee

For those who want to modify the design, the centre distance of the knee pin to the mainshaft is the critical dimension that governs the throw of the lifting arm. Since the handle moves about 90 degrees, the throw exactly equals this distance (ie. 15/16". Different angles would of course affect this up or down. While this may seem to be an unnecessarily large distance, it must be reduced by a certain fraction. If:- D is the offset distance of motor shaft to mounting hinge axis; L is distance from that axis to the lifting arm attachment point; and theta is the angle made by the motor shaft, the hinge pin axis, and the lifting arm attachment point; Then:-

cos (theta) x D

Final nett. travel of motor shaft = x throw of knee.

L (=Approx).

This should be at least ½" and preferably ⅝" or more. Mine turned out on measurement to be 13⁄16".

You don't need to calculate this unless your motor is at 60 degrees or more to the horizontal, when the throw might no longer be adequate. To increase the throw just lengthen the knee side pieces and increase the distance between the mainshaft and the knee pin holes. The other end length can stay much the same (about 1¾" is long enough to make a good knee).

On my machine the mounting plate makes an angle of about 10 degrees to the horizontal, and the motor shaft an angle of about 40 degrees with that. The nett effect is to still give a measured 13⁄16" of travel for the motor shaft along a line between pulley centres, i.e. between the engaged and disengaged positions of the clutch. This is more than adequate, but if your roller bar is not quite right and you happen to end up with too much clearance for the rollers, or the motor sits at a very steep angle, it may not be. Note that increasing the throw of the knee does **not** solve the problem of different centre distances for the two speeds.

Gear cover cut-out

There are two places where the gear cover must be cut away.

1. The rear roller comes exactly opposite the rib on the back of the gear cover, so cut this away for a width of about 1¾" opposite the roller. It is a difficult and awkward sawing job, but, do not extend the cut onto the front, which would spoil its appearance. Cut only as deep as is needed for the length of the roller and stud assembly. On my machine this is a depth of 2¾" as measured forward from the edge of the cover that contacts the the lathe headstock.
   The opening will of course be visible at the back of the cover because the roller projects through it. It cannot be avoided.
2. The motor now drops lower than it could previously, so it is necessary to extend the cut-away for the pulley at the bottom back corner of the cover. Again, do not extend the cut to the front plate. On my machine, it is 2⅜" deep and in fact, it is simply an extension of what is the existing bottom opening, a little higher up the back (about ¾"). Also bevel the inside of the upper edge of the cut to give the pulley extra clearance, because that saves having to cut more of the back out. The bevelling is more important opposite the larger outer sheave. This cut is right at the bottom, so it wont be visible from either the side or the back of the lathe.

The spring bracket

The bottom end of the spring is attached to the motor by means of a small 100 degree angle bracket that is bolted down under the rear mounting bolt of the motor at the pulley end. Space is very tight here. The mounting bolt has to be inserted from below.

The vertical limb of the bracket has to reach up at least 4" so it gets round the main bulge of the motor so that the spring can be attached clear of the motor.

Operating the clutch

The motor bounces significantly when it turns on due to the starting torque. This tends to be transmitted to the clutch handle and causes that to bounce too. This is not a problem since there is no force involved — it is purely a torque reaction that occurs only on switch-on. You can, if it is annoying, hold the clutch lever when you start the motor. I usually don't bother.

One restriction

The device in its existing form doesn't allow for a separate motor mount. If you are having problems where turned work has a wavy surface that just wont go away, chances are it is motor vibration transmitted through the frame to the lathe and thence to the job, and often the only remedy may be to mount the motor on a separate stand bolted to the floor.

Certainly it could be incorporated into the present device but it would require radical redesign. One spin-off of the separate motor mount is that it no longer requires those pesky raising blocks!

More improvements

After fitting of a clutch to a geared head lathe the most important minor modification is to lift the lathe bodily off the stand and tray unit by at least one inch. This is because the motor as currently supplied is too large and fouls the lip of the tray making belt changing and tensioning very difficult. Lifting the whole lathe 1" off the tray is enough to solve the problem by giving sufficient room for the motor to pivot properly on its mount. The lathe is raised by means of 1" thick raising blocks under the two feet.

Raising blocks

These should really be fitted whether or not you are fitting the clutch mechanism to the AL960B. The raising blocks are made of 25mm square x 3mm RHS welded into hollow rectangles of the same outer dimensions as the lathe-bed feet plus an extra few mm all round. 25x37mm could also be used 'on the flat' but be sure to use a heavy gauge.

My dimensions for the blocks were:

Headstock end — 9 x 8 inches, attached with 4 x ½" bolts.

Tailstock end — 8¼" x 7¼", attached with 2 x ½" bolts.

Skim the surfaces of the welded pieces lightly with a 2½" diameter carbide-tipped face-milling cutter. This removes any welding distortion and finishes them smooth and flat, taking only minutes to do. However, it would be very slow with an HSS fly cutter.

Cut two pieces of 1 mm fibre-based gasketting for each foot size. One gasket goes on top and one under each block to seal against any leakage of coolant from the tray into the cabinets where it could make a bit of a mess. Drill the blocks to suit the mounting feet bolt-holes. It is best to wait until the lathe is lifted to get these dimensions. Punch the gaskets 9⁄16" for the bolt holes.

I lifted the lathe means borrowing a two tonne hydraulic hoist and a chain or lifting harness. The one I used was the same as the one Hare and Forbes advertise. It is often used in garages to lift the engine out of a vehicle chassis. With the lathe balanced as best as possible and lifted about 6", position the blocks and gaskets, lower gently and try the bolts. If OK, lower fully and tighten up. In fact this proved harder to manage than might be expected, mainly because it is not possible to completely balance the lathe with the limited lifting points available. It therefore takes one or two people to manhandle it, and it was also made more difficult because the bolts in the headstock end cannot be inserted from the top. Another person has to hold and juggle them from underneath inside the cabinet. To say it is awkward is to put it mildly. The two tailstock bolts are easier because they can be inserted from the top, but it still requires someone at that end as well.

So it really takes at least three people to rebolt the lathe. Naturally, you will have to supply ½" bolts one inch longer than those originally used.

I recommend that you measure and drill the holes in the blocks to suit the the feet and/or the stand while they are lifted apart because in my case the stand was not correctly drilled to suit the feet. I even had to undo the two ends of the stand from each other where they were joined by the sheet metal plate that forms the back and undertray before I could get it to line up again.

Compound slide angle scale

This was only graduated 45 degrees each side in the front so with an index mark at the left side, only a small range of angles can be set. Another problem is that the scale is obscured by the front and back part of the slide when it is rotated nearly parallel to the cross slide. Therefore you should scribe duplicate witness marks on both sides of the compound slide top.

Remove the compound slide and make a plug from a piece of 1" aluminium rod that closely fits the hole in the cross slide top but with a thin lip to stop it falling through. My plug was 0.990" diameter by ½" long.

Scribe crosshairs on the top. With the plug in the hole, lay an accurate protractor in position and scribe fine lines at 5 degree intervals on the blank side to complete the graduated circle. Also mark 14½ degrees (ACME), 27½ and 55 degrees (Whit) and 30 and 60 degrees (US and metric), and 47½ and 23¾ degrees (BA), all on each side.

Continued on page 46...

Bracken Ridge Central Official Opening

by Dave Harper

On Sunday 24th March 1996 miniature railways in Brisbane received a great publicity boost.

The 5" guage track runs through McPherson Park in the outer Brisbane suburb of Bracken Ridge. The track was laid for and by the Bracken Ridge Central Lions Club, with the intention of providing rides for local residents and at the same time raising funds for the Lions Club.

A prime mover, and chief technical adviser for the whole project was Neil Mackenzie, a name familiar to most AME readers. Apart from being a local resident, Neil is a great exponent of QGR steam locos on the 5" guage.

As a tribute to the time and effort that Neil gave to the project, a plaque was unveiled naming the track "The Mackenzie Line". Thanks to Neil's influence no less than 32 steam locos and their owners gathered on the day, from as far afield as Bundaberg, Maryborough, Nanango and Gatton as well as many nearer locations. About 25 locos actually operated, more due to a lack of drivers than lack of will.

McPherson Park was really buzzing — with many local community groups having stalls, rides for the kids, the Antique Machinery group with their little engines, and just about the whole of north Brisbane turned up for the day!

Bob Scheuber, Deputy Chief Executive of Queensland Rail, performed the opening ceremony and drove the official train.
Photo by courtesy of the Brisbane Courier Mail.

The queue for rides didn't seem to shorten all day, and many drivers were pretty stiff and weary as the day wore on! It is proposed to operate on the third Sunday of each month, and it's already proved a popular attraction with the locals.

The track itself is a welded steel structure embedded in concrete so as to be as near vandal proof as possible. The steel and concrete were donated by local companies and the local TAFE college did most of the track production. Neil and numerous volunteers laid the 600m or so of track. Another local company donated a cover for the station area, very welcome in our climate.

The layout is a basic dog-bone with a couple of bends in the middle. One loop runs among a stand of trees and the other higher up behind a sports field. This top loop is on a fair grade and is a bit of a challenge for the smaller locos!

An important part of the infrastructure is the ingenious loco transporter designed and built by Neil Mackenzie. Operated through cables by an hydraulic

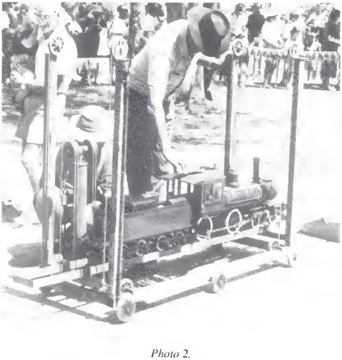


Photo 2.

Photo 3.

Photo 4.

Photo 5.

Photo 7.

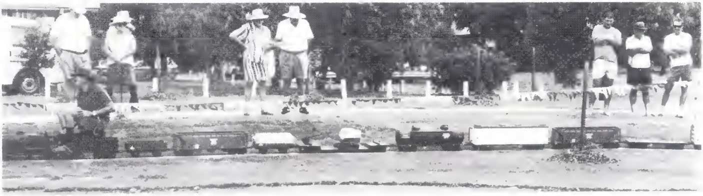


Photo 6.

Photo 8.

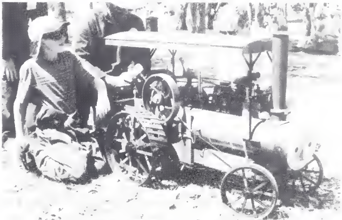


Photo 9.

Photo 10.

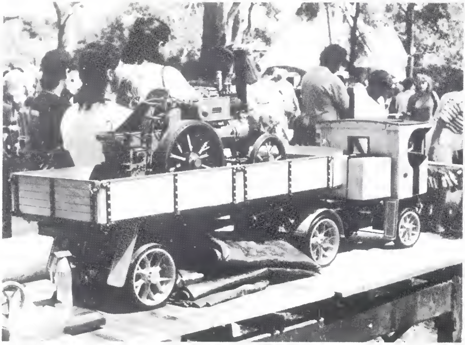


Photo 11.

ram, it enables locos to be unloaded from vehicles and moved onto either the portable steaming bays or direct onto the track. The system seemed to work very well and was much appreciated by all the operators. **Photo 2** shows the unloader in use by Dale Dietman preparing to put his QR A12 on the track.

Photo 3 shows Warren Star driving his 3807 under the station awning to pick up another load of passengers.

Photo 4 shows that passengers came in all shapes and sizes! Fred Gough from Burrum Heads (North of Maryborough) driving his 3801.

Photo 5 shows the temporary sidings laid for the day to accomodate the extra locos. Ken Saunders' Heisler in the foreground.

Bob White from Dalby generated a lot of interest with his rake of NSWGR goods wagons circulating behind his C36 class loco. I got as much as I could of his train in **photo 6**!

Photo 7 shows the top loop with a string of trains headed by Ray Schilling from Nanango on his QR A10 heading up the grade.

An unusual prototype was the South African Raiways 16DA class built by Ted Catchpole from the Sunshine Coast. Very eyecatching in its blue livery, **photo 8**.

The Carseldines were there with their Cliff and Bunting traction engine, **photo 9**.

Old friend Bobby Kimber from Maryborough emerges from the trees behind his NSW class 36 loco in **photo 10** and finally some examples of Eric Abbott's workmanship in his prize-winning Clayton Steam Wagon, traction engine and hot air engine are in **photo 11**.

Altogether a great effort by the local community and a credit to the model engineering fraternity.

Valve Event Diagrams

Part 2 — Conclusion

By Jack Henshall

Drawings for publication by Rod Heslehurst

Walschaert's Valve Gear

In Walschaert's gear the addition of the two motions OX and OY is carried out by the combination lever, and the reversal of OY is obtained from the die block in the slotted link from the return crank at 90 degrees to the engine crank. Moving the die block towards the pivot point of the link reduces OY for linking-up. The gear is so designed that for maximum valve travel (i.e. full gear) the valve rod receives the sum of the components OX and OY necessary to provide the travel to the equivalent eccentric, which enables Bilgram's construction as previously described to be used in determining the valve events, port openings and lead. As this article is concerned with valve event diagrams it is thought that the design of the valve gear to provide OX and OY ought to be left to another time.

Exercise 3

The general arrangement of Walschaert's gear for *Simplex* has been reduced to an identical centre-line schematic and the inter linking points of the members identified in Figure 9. Tables 4 and 5 show the dimensions and calculations relevant to determining OX and OY for full gear. From the dimensions of the cylinder port face and the D valve (Figure 10) the valve laps are found. Figure 11a is the Bilgram's diagram drawn as in Exercise 1 for full gear, but constructing the angle of advance (a) from its tangent equal to OX/OY, noting that OY is along AB. It is most important not to interchange OX and OY in this construction. Table 6a lists the full gear valve event timings, port openings and lead for Simplex.

With Walschaert's gear, variable cut-off is provided by linking-up to reduce OY. Valve event diagrams giving timings for release, compression and admission for a range of cut-offs can be readily drawn. So continuing Exercise 3, lets examine Simplex at cut-offs of 50% and 20% (nominal) of piston travel. Figures 11b and 11c show the resulting diagrams. In drawing these diagrams, a crank rotation circle, centre O, to give the nominal crank angle positions at 50% and 20% of piston travel is first drawn as in Exercise 2. As OX is constant for all cut-offs, the equivalent eccentric point E lies on a line MN parallel to AB with a scaled distance from AB (re OX scaled) equal to the steam lap plus lead (scaled). Thus the centre of the steam lap circle E lies on MN at a point E such that the steam lap circle is tangential to the cut-off crank positions. Once E is located the remainder of the construction follows Exercise 1. OE is of course half the valve travel at the particular cut-off. It should be noted that although the lead is constant, the crank angle at admission becomes earlier as the cut-off is decreased. Tables 6b and c give the valve events and port openings for both strokes at these cut-offs.

ITEM	RELATIONSHIP — EXPRESSION	RELATIONSHIP — NUMERICAL	VALUE
OX Component of Valve Travel	$OC \times \frac{KL}{KM - KL}$	$1\frac{1}{16} \times \frac{5/16}{2\frac{11}{16} - 5/16}$	0.14
OY Component of Valve Travel	$OY^2 = OE^2 - OX^2$	$\sqrt{(\frac{1}{2} \times \frac{9}{16})^2 - 0.14^2}$	0.244
OD (Drive for OY Component)	$OD^2 = CD^2 - OC^2$	$\sqrt{1\frac{3}{16}^2 - 1\frac{1}{16}^2}$	0.53
OY (nominal)	$OD \times \frac{GH}{GF} \times \frac{KM}{LM}$	$0.53 \times \frac{5/8}{1.5} \times \frac{2\frac{11}{16}}{2\frac{3}{8}}$	0.25
a (Angle of Advance) full gear	$\tan a = \frac{OX}{OY}$	$\arctan \frac{0.14}{0.244}$	29.8°
'n' Con rod/Stroke Ratio	$n = \frac{CP}{2 \times OE}$	$\frac{7}{2 \times 1\frac{1}{16}}$	3.3

TABLE 5 Equivalent Eccentric ***Simplex*** *Full Gear*

Summary of Exercise 3

Valve event timings and port openings at an early cut-off as typified by Table 6c were found most surprising when analysed some years ago during an examination of alternative designs of a valve gear for a steam wagon.

Simplex is an 0-6-0 "goods" with full gear providing appropriate valve events but at early cut-off a maximum steam port opening of little more than lead, with release and compression occurring not much after half stroke, give much food for though. If the engine can perform satisfactorily at "high" speed with early cut-off, with such a small valve opening for steam and only a short time for steam admission, why are the large opening necessary in full gear for starting or hill climbing at low speed when the time for steam flow into the cylinder is so much longer? What are the constraints limiting valve openings at short cut-off, and what can be done to provide larger

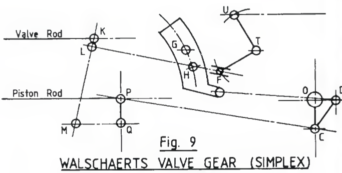


Fig. 9
WALSCHAERTS VALVE GEAR (SIMPLEX)

Connecting Rod	CP	7"
Crank Arm	OC	1 1/16
Return Crank	CD	1 3/16
Expansion Link Drive Radius	GF	1 1/2*
Die Block (full gear) Position	GH	5/8*
Combination Lever	KM	2 11/16
Radius Rod Connection Position	KL	5/16
Valve travel (Full gear)	2 x OE	9/16"

TABLE 4 RELEVANT DIMENSIONS ***SIMPLEX*** *VALVE GEAR*
Exercise 3
** Due to backset and angularities, full gear valve travel is not precisely determined from these dimensions, hence OY is calculated from specified full gear travel as detailed in TABLE 5.*

openings? Can release and compression be later to provide a longer expansionandlesscompression?

Figure 12a reproduces part of Figure 11c showing again the steam port opening of 0.028 inches at 20% cut-off for the 1/8" steam lap and 0.015" lead. Also shown is the port opening for a lap of 3/16" retaining the 20% cut-off and 0.015" lead; the opening is now 0.033" achieved at an increase in the OX component of valve travel of 1/16". Figure 12b reproduces part of Figure 11a which gave a cut-off of 80% for the full gear valve travel of 9/16", together with the equivalent eccentric position E required for 80% cut-off and 0.015" lead with 3/16" lap. The valve travel required (i.e. 2 × OE) is now excess of 13/16". The crank angles for release and compression have not been significantly altered as the equivalent angle of advance has been little changed by the increase in steam lap.

If lead is required to provide for a build up of pressure inside the cylinder by the time the piston has reached dead centre when running fast, it is necessary when starting or running at slow speed? Appreciating that the crank angle has to be 10 to 15 degrees past dead centre before the crank arm is in a position for the piston force to produce any appreciable torque it is obviously debatable whether lead is necessary for full gear operation at low speed. In fact even negative lead for such operation may be usable! Figure 12c has been drawn with negative lead of 0.025", 3/16" lap and cut-off as in Figure 12b. The valve travel has been reduced to under 3/4".

There would appear to be some advantages in a valve gear that provides variable lead such that the lead increases as the gear is linked-up for earlier cut-offs. Such a gear was in common use in locomotives at the turn of the century, of course it is Stevenson's, and a most successful application of this will be examined for Exercise 4.

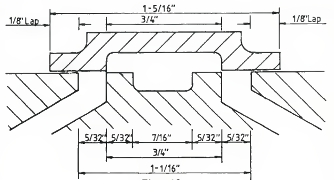


Fig. 10
SIMPLEX
PORT FACE & VALVE DIMENSIONS

Stevenson's Valve Gear

Stevenson's link motion as used for D valves and with the normal "open rods" is shown schematically in Figure 13a for clockwise rotation in full gear. The valve motion and event timings in this position can be considered as that provided by eccentric OE, any contribution from OE′ being negligible. Thus for full gear Bilgram's diagram is based on the travel and angle of advance of OE. In Figure 13b, the gear is linked-up so that position D is midway between full gear and mid gear i.e. AD = 1/4 AB. In this position OE′ contributes significantly to the valve motion which can be attributed to an equivalent eccentric (OQ). Figure 14a shows a graphical method of determining this equivalent eccentric, proof of this construction is again given in Reference 1. Using this equivalent eccentric Bilgram's diagram can be constructed for any position of the slider block in the link.

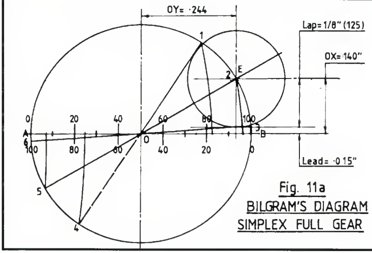


Fig. 11a
BILGRAM'S DIAGRAM
SIMPLEX FULL GEAR

	Inward Stroke		Outward Stroke	
VALVE EVENT	POINT	PISTON TRAVEL	POINT	PISTON TRAVEL
Admission	6	-1%	3	-
Cut-off	1	82%	4	75%
Release	2	96%	5	93%
Compression	5	-7%	2	-5%

Note: OX = Lap + Lead
Max. Port Opening = 5/32"
TABLE 6a VALVE EVENT TIMING
***Simplex** Full Gear*

BILGRAM'S DIAGRAM
SIMPLEX
NOMINAL 50% CUTOFF

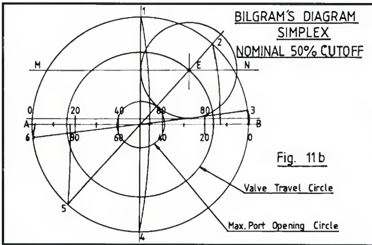
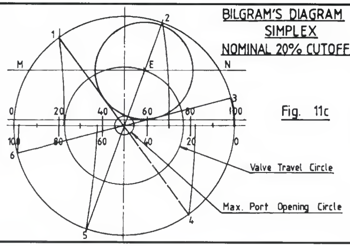


Fig. 11 b

	Inward Stroke		Outward Stroke	
VALVE EVENT	POINT	PISTON TRAVEL	POINT	PISTON TRAVEL
Admission	6	-1%	3	-
Cut-off	1	54%	4	46%
Release	2	87%	5	82%
Compression	5	-18%	2	-13%

Valve Travel 0.385"
Max. Port Opening 0.067"
TABLE 6b VALVE EVENT TIMING
***Simplex** 50% cut-off*



	Inward Stroke		Outward Stroke	
VALVE EVENT	POINT	PISTON TRAVEL	POINT	PISTON TRAVEL
Admission	6	-2%	3	-1%
Cut-off	1	23%	4	18%
Release	2	70%	5	62%
Compression	5	-38%	2	-30%

Valve Travel 0.300"
Max. Port Opening 0.025"
TABLE 6c VALVE EVENT TIMING
***Simplex** 20% cut-off*

The inverse requirement to find the link position that provides a specified valve event timing (cut-off example) is simplified if a locus line for the equivalent eccentric centre (Q) can be drawn on a basic Bilgram's diagram, as is shown in Figure 14b. Here the eccentrics OE and OE′ are shown as for a full gear Bilgram's diagram and an arc EME′ with radius R as determined for Figure 14a is drawn through E and E′. This arc is the locus of the centres of the equivalent eccentrics for a linked-up gear. By drawing the lap circle with its centre on this arc and tangential to the crank angle for the required cut-off, much as in Figure 11b where the lap circle centre was located on the constant lead line MN, the equivalent eccentric OQ providing the specified cut-off is found. Using the ratios $\frac{EQ}{EE'} = \frac{AD}{AB}$ the link up position of D on AB is located.

Exercise 4

George Jackson Churchward is a name revered in the annals of the history of British locomotives for engines of, in his time, unsurpassed performance and economy. The application of long lap, long travel valves driven by his adaptation of Stevenson's link motion in the Great Western Railways *Saint* class 4-6-0 contributed to a standard of performance which other railways eventually were able to follow. So for this exercise let's explore the diagrams for a Stevenson/Churchward gear as in the two cylinder *Saint* express locomotives. The data has been extracted from References 2 and 3, noting that outside cylinders with inside admission piston valves driven by a rocking lever from the inside valve motion was used. The engines had a long life and without doubt, changes to the valves and their drive were made during this time. The data used cannot be attributed to a specific build standard and some has been scaled from a small reprint drawing. Thus any disagreement with the information used, will not be disputed, it is solely used to illustrate Bilgram's construction in this unique, successful application of Stevenson's gear.

The arrangement of the Stevenson's link motion as used in the *Saint* engines has been reduced to a centre line schematic in Figure 15 and the dimensions required to determine the data for a valve event diagram are listed Table 7. Table 8 shows the calculations for the radius of the locus of the centres of the equivalent eccentrics. As the motion includes a rocker shaft with unequal arms, the full gear valve travel and the radius of the locus for the equivalent eccentric centres have to be

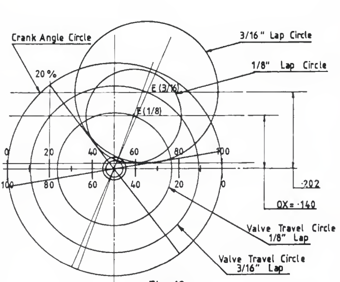


Fig. 12a
PORT OPENING 3/16" LAP 20% CUTOFF

	1/8" Lap	3/16" Lap
Valve Travel	0.300"	0.440"
Port Opening	0.025"	0.033"

Table for Figure 12a

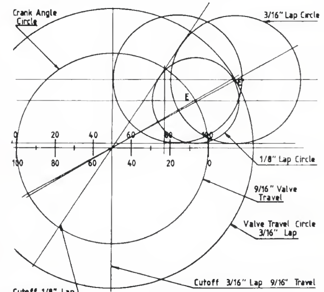


Fig. 12b
VALVE TRAVEL 3/16" LAP FULL GEAR

For 77% cut-off 3/16" lap, Valve travel = 0.82"
For 9/16" Valve travel 3/16" lap, Cut-off = 50%.

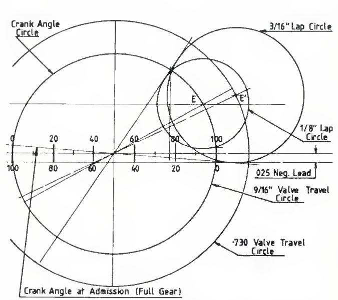


Fig. 12c
VALVE TRAVEL 3/16" LAP FULL GEAR NEGATIVE LEAD

for 3/16" lap and 0.025" negative lead, valve travel = 0.73"

adjusted by the ratio of the lengths of these arms. Figures 16a and b show the resulting valve event diagram for full gear and 20% cut-off respectively. The valve event timings are given Tables 9 and 10.

Summary of Exercise 4

Although Stevenson's gear increases the lead as it is linked-up this is not necessarily detrimental to the gear in providing a first class performance. It appears that the design of the gear ought to be based on operation in the linked-up position appropriate to the expected operational conditions and accept a compromise for the full gear starting and low speed operation. It is said of the *Saint* engines that their starting and low speed hill climbing performances were superior to equivalent 4-cylinder engines with Walschaert's gear (Ref 2).

It would be most interesting to compare the valve events of Tables 9 and 10 with the valve events of the VR Stevenson's A2 4-6-0, a somewhat contemporary engine to a *Saint* but fitted with the traditional Stevenson's locomotive link and long eccentric rods.

Before leaving the readers with a final exercise, there are a number of small matters not yet covered in this review: viz

1. The lap of inside admission piston valves is represented in Bilgram's diagrams for both types are identical in construction.
2. Negative exhaust lap gives a longer exhaust period, having an earlier release and later compression. Hence on a Bilgram's diagram the crank angles for these events are drawn tangential to the exhaust lap circle on the opposite sides of the lap circle to those of Figure 7b of Exercise 2

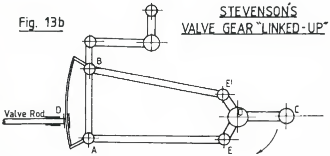
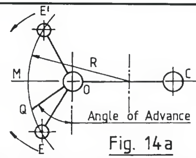


Fig. 13b
STEVENSON'S VALVE GEAR "LINKED-UP"



$$R = \frac{EE' \times EA}{2 \times AB}$$

$$\frac{QE}{EE'} = \frac{AD}{AB}$$

see Figure 13b

OQ = equivalent eccentric

Fig. 14a
EQUIVALENT ECCENTRIC FOR STEVENSON'S GEAR "LINKED UP"

3. In Stevenson's link motion as illustrated Figure 13a, eccentric OE, could have its eccentric rod connected to point B of the link, with OE' to point A. These rod connections are termed "Crossed rods" and under these conditions the lead reduces as the gear is linked-up. To find the equivalent eccentric in the linked-up condition, the arc EME' Radius R of Figure 14a is drawn with its centre on the opposite side of EE' i.e. concave towards O. If such an arc is used for the locus of the centre of the equivalent eccentric in Figure 14b, it is readily seen that in addition to the lead decreasing as the gear is linked-up, the maximum port opening rapidly diminishes. A condition to be avoided at all costs, hence constructors of Stevenson's link motion should ensure that the rods are "open" when the crank is at the outer dead centre. In most assemblies the rods can be connected either way!.
4. In exercise 3 and 4 the reduction in maximum port opening for steam admission to the cylinder, with linking-up is featured, but the other function of the valve — to provide a passage out of the cylinder for the exhaust is not discussed. High pressure steam, particularly if superheated is extremely fluid and has little difficulty in passing through the small admission opening, but the expanded volume of the exhaust at a lower pressure requires much greater port areas if the piston is not to be unnecessarily obstructed in its return stroke. Thus, whilst the admission port opening may be a minor fraction of the cylinder port width, the valve opening for exhaust can, with benefit, exceed the width of the cylinder port. Attention is needed in

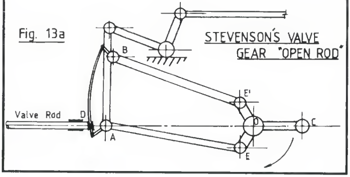


Fig. 13a
STEVENSON'S VALVE GEAR "OPEN ROD"

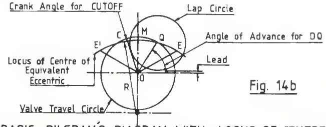


Fig. 14b
BASIC BILGRAM'S DIAGRAM WITH LOCUS OF CENTRE OF EQUIVALENT ECCENTRIC STEVENSON'S GEAR

the design of the cylinder port face, particularly for the width of the exhaust port, to ensure that the port width is adequate, particularly with long travel valves where the inner edges of the exhaust cavity in the vale (D type) can readily overrun the edge of the exhaust port in the cylinder face. Negative exhaust lap does increase the exhaust port opening but this is normally quite a small increase. For negative lap the maximum exhaust port opening is shown on Bilgram's diagram by the distance from the centre 0 to the outside of the exhaust lap circle, not as shown in Figure 7a (exercise 2) to the inside edge of the exhaust lap circle, which is for positive exhaust lap.

5. The even beat of the sound of a locomotive, large or small, shifting a good load up a long incline brings joy to all associated with it. This beat requires the pressures and volume of steam release for all strokes in a revolution to be approximately equal and the points of release to be equally timed in revolution, i.e. at equal crank angles not equal piston travels. For this timing it is important that the exhaust cavity in the valve travels symmetrically over the cylinder ports, requiring the valve position on the valve spindle to be correctly set. The pressure and volume of steam and release is dependent on the volume of steam in the cylinder including any clearance volume and that in the cylinder ports and the ratio of expansion of this volume to the comparable volume at release. Hence Bilgram's diagram showing the piston travels at cut-off and release can be used to give some guidance as to the equality of the beats. It is not necessary for the laps at each end of the valve to be equal and this can be used for some adjustment to obtain equal cut-offs in the inward and outward piston travels. This, of course, is subject to acceptance of unequal leads and port openings at the opposite ends of the cylinder. Again compromise at the choice of the designer, assisted by studies of the appropriate valve event diagrams, is involved.

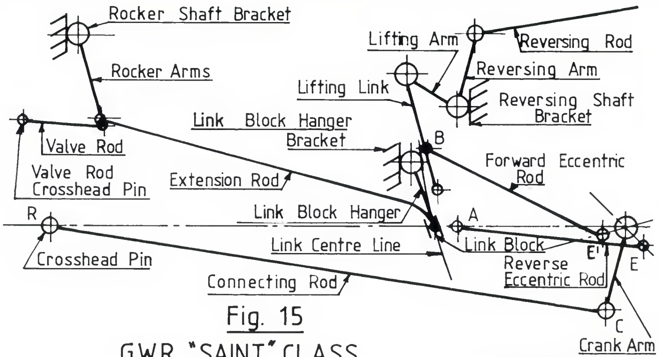


Fig. 15

GWR "SAINT" CLASS
STEVENSON'S / CHURCHWARD
LINK MOTION

Eccentrics Arranged for Inside Admission Piston Valves

Stroke (2 × *OC*)	30"
Connecting Rod length (CR)	10′ 7½"
Eccentric throw (OE)	3"
Angle of advance (a)	27°
Eccentric rod length (AE)	3′ 10"
Link centres (AB)	1′ 1"
Rocker arm extension rod (Le)	11½"
Rocker arm valve rod (Lv)	12"
Lap	1⅝"
Exhaust lap	Nil
Valve travel (full gear)	6¼"

*TABLE 7 **SAINT** VALVE GEAR DIMENSIONS*

ITEM	RELATIONSHIP		VALUE
	EXPRESSION	NUMERICAL	
Con rod/Stroke ratio (n)	$\frac{CR}{2 \times OC}$	$\frac{127.5}{30}$	4.25
Eccentric centres (EE')	$2 \times EO \cos a$	$2 \times 3 \times \cos 26$	5.39
*Radius locus equivalent eccentric (R_L)	$\frac{EE' \times AE}{2 \times AB}$	$\frac{5.39 \times 46}{2 \times 13}$	9.54
Rocker arm ratio (r)	$\frac{Lv}{Le}$	$\frac{12}{11.5}$	1.043
Valve travel full gear	$2 \times OE \times r$	$2 \times 3 \times 1.043$	6.26
#Radius locus equivalent eccentric (Rv)	$R_L \times r$	9.54×1.043	9.95

TABLE8 BILGRIMS' DIAGRAM DATA
** - Referred to link motion, # - Referred to valve travel*

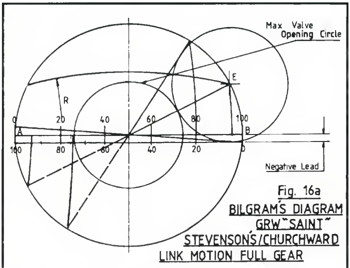


Fig. 16a
BILGRAM'S DIAGRAM
GRW "SAINT"
STEVENSON'S/CHURCHWARD
LINK MOTION FULL GEAR

EVENT	INWARD STROKE	OUTWARD STROKE
Admission	+1%	-
Cut-off	80%	76%
Release	96%	94%
Compression	-6%	-4%

Lead (negative) 0.20
Maximum port opening 1½"
TABLE 9 VALVE EVENT TIMINGS
*GWR **SAINT** FULL GEAR*

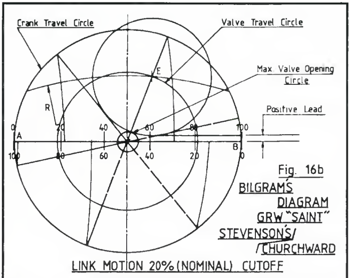


Fig. 16b
BILGRAM'S
DIAGRAM
GRW "SAINT"
STEVENSON'S/
/CHURCHWARD
LINK MOTION 20% (NOMINAL) CUTOFF

EVENT	INWARD STROKE	OUTWARD STROKE
Admission	-2%	-
Cut-off	22%	17%
Release	71%	65%
Compression	-35%	-29%

Valve travel 3.84", Lead 0.18"
Maximum port opening 0.30"
TABLE 9 VALVE EVENT TIMINGS
*GWR **SAINT** 20% CUT-OFF*

Marine steam

In miniature steam locomotives, with valve gear and throttle controls, combined with the drivers sensing of the engine's behaviour, there is ample provision for the driver to choose the best control settings for any of the varying operating conditions found during his run.

Stroke	28" } n = 4.6
Con rod length	10ft 9 inch approx }n = 4.6
Steam lap	1 11/16"
Exhaust lap	Nil
Lead	¼"
Max travel full gear (forward)	7⅞"
Max. cut-off full gear (forward)	78%
Note: OX (see fig.11a) = Lap + lead = 1 15/16"	

TABLE 11 VALVE GEAR DATA B.R. CLASS 9 (WALSCHAERT'S GEAR)

Model marine plants do not require such flexibility, operating under a load varying only with engine speed (once the propeller has been selected). There does not seem to be any purpose in varying the valve operation (even with radio control other than for reverse,) if the valve events have been designed for efficient operation. Having rebuilt a number of commercial engines it is my view that the valve timing of any such engine should be examined in an event diagram, particularly for any new construction, more so if required for fast running. In single cylinder engines which are not self starting anyway, cut-offs in the range 50-60% lead 1½ - 2% admission port opening 5%, cylinder port openings 10% and exhaust port opening in the cylinder valve face 20% of the stroke; port length at about 50% of cylinder bore will be found suitable. Such an engine seems to sparkle particularly with superheated steam. For long stroke, low speed engines such as could be directly coupled to paddle wheels, dimensions related to stroke can be reduced to 50-60% of those given above. It does not take much of a steam loop in a firebox even if methylated spirit fired, to provide a superheat temperature quite capable of melting soft soldered joints along the steam line. With a more effective superheater, a copper main steam line will become soft, viewed in the dark, they do appear dull red!

EVENT	CUT-OFF							
	FULL GEAR		50%		20%		15%	
	IN STROKE	OUT STROKE	IN STROKE	OUT STROKE	IN STROKE	OUT STROKE	IN STROKE	OUT STROKE
Cut off%	80.5	75.6	51.8	48.3	19.5	20.6	14.4	15.4
Release%	94.0	91.8	83.8	80.2	67.2	65.5	62.2	61.7
Compression%	91.8	94	80.2	83.3	65.5	67.2	61.7	62.2
Max. port opening	2.19"	2.31"	0.81"	0.875"	0.33"	0.36"	0.30"	0.30"
Valve travel	7.875		5.06		4.06		3.97	

TABLE 12 VALVE EVENT TIMINGS AND PORT OPENINGS, B.R. CLASS 9 2-10-0 (WALSCHAERT'S GEAR)

For twin cylinder engines, which are required to be self starting, a somewhat later cut-off is needed, at perhaps a crank angle of 105-110 degrees with admission not earlier than 5 degrees before dead centre.

Exercise 5

For those who would like to have hands-on experience of valve event diagrams and do not have a pet engine to explore, Exercise 5 is set (together with the

official answers) on the last steam locomotive designed by British Railways — the Class 9 two-cylinder 2-10-0 mixed traffic *Evening Star*. This shows the final word on valve event timings! Table 11 shows the valve gear dimensions necessary for the valve diagram and Table 12 gives the official event timings and port openings for full gear, 50%, 20% and 15% cut-offs, at 20% really remarkably comparable to Churchwards *Saint* of some 50 years earlier. *Simplex* is also similar at 20% cut-off.

In conclusion, it can only be said that engineering is the choice of options and compromises, none more so than in the design of steam engines where selection of boiler pressure, cylinder size, port openings, cut-off, lap, lead, valve travel etc., all inter related, remain the prerogative of the designer. Bilgram's diagram is a design tool providing the relationship of the various valve functions. Many are the hours that have been spent juggling dimensions in a new venture, hoping to find an optimum but ending up merely with a solution judged "acceptable". So do explore any prospective project and see, before accepting the written word, if you agree with the designer. It is your time and resources being expended, which entitles you to a vote on his choice of compromises. Good Steaming!

References

1. *The Theory of Machines*, Thomas Bevan, 3rd Edition
2. *The British Steam Railway Locomotives 1925-1965*, O.S. Nock
3. *Locomotives I Have Known*, J.N. Maskelyne

Loco Boiler Repairs continued from page 23...

If the enginemen aren't skillful...

In a more serious case the following would be reported:

"Top of crown adjacent to the tube plate shows signs of scorching, Top row of flue tubes scorched, first two rows of crown bolts were hammer tested and found loose, the crown plate between these two rows of crown bolts was corrugated. I recommend the engine be hauled to workshops for repair. In my opinion the fusing of the plugs was due to insufficient water in the boiler."

A further investigation by the Rolling Stock Superintendent, Depot Foreman and the enginemen concerned to ascertain why there was low water in the boiler causing the fusing of the plugs. Sometimes it necessitated forwarding the plugs to the Metallurgy Laboratory at Newport for a further opinion.

The fusing of the plugs in a locomotive boiler is a very serious matter and has to be thoroughly investigated, and the result can be that the enginemen concerned could be reduce from Driver to a labourer, in some cases never to return to a driver again.

Some may regard the procedure regarding all the gauge glass testing as irreverent but it is to prove all the mountings were in good order showing the correct height of water in the glass.

Lathe Clutch continued from page 36...

Extending the carriage travel

The power control lever on the right of the carriage sticks out so that it ultimately limits the carriage's travel to the right by hitting the bearing block attached to the bed that supports the three shafts — the screwed lead screw, the keywayed power feed shaft, and the keywayed on-off control shaft.

After disconnecting the power:- remove that block, letting the carriage hold the shafts up in the meantime, and mill a ½" wide notch 1" x 1" deep on the bottom inner front corner. Remove the collar on the power control shaft and thin it down by ⅛". Replace the collar in its new position and retighten its grub screw. Admittedly this only gains about half an inch but it isn't difficult and may be necessary someday. I needed the absolute maximum length to cut a long screw to make a drill press table lifting mechanism. (This job may be the subject of another article).

A similar but in some ways worse problem afflicts the carriage on the left side where the main power switch box fouls the carriage when it comes close to the headstock. It can affect work on centres, especially in collets, and on the face plate but it is unlikely to affect work in the chucks because these stick out by an additional 3 inches or so.

Unfortunately there is no easy fix for this. Just be warned that when you are working close to the headstock with auto feed you may not realize that the carriage is dangerously close to the switch body. I got caught by this while working with collets and was lucky to have escaped serious damage. One way to guard against it is to have the compound slide in the longitudinal position and well advanced so it overhangs to the left as much as possible.

Indexing in the lathe

It is extremely useful to be able to index holes in things like cylinder covers, by scribing the job with a lathe tool while it is still in the chuck.

So mount your chuck back-plate on a dividing head in the mill and index the rim of the back plate for 48 or 60 holes (suit yourself which — 48 gives 12 and 16 divisions whereas 60 gives 15 or 20). Drill the holes with a centre drill with a ⅛" pilot and arrange a stop on the feed so it goes just deep enough to put a chamfer on the start of the hole.

The index pin is a short pin with a ¼" shank and a tapered ⅛" diameter tip to fit in the index holes. The body is ½" knurled steel about 1½" long. It is mounted in a guide tube on a bracket that is bolted to the piece of 1"x 1" angle we fitted to the top of the headstock when making the clutch frame. The pin is removed when not in use so it is not in the way. To index, just drop the pin in the guide.

Of course, the guide must be accurately placed in the left to right direction to correspond to the line of holes, and so it will be difficult to get a line of holes in the same position on different back-plates. I had that problem and eventually had to solve it by mounting the guide tube in a slot in the bracket so it could be adjusted and then locked with a nut.

Front panel accessories switch

The final modification is to fit a double slide-switch box onto the nameplate face of the headstock in the spare space at the bottom left hand corner. I used a Clipsal type IP-54 double switch box 3½" x 3" and about 1½" high. It is an all-weather box with a sealing rubber ring under the front cover. This stops any ingress of suds.

I tapped holes in the headstock to attach it and drilled a ½" hole to pass some cord back inside to come out at the L side of the foot 2" up from the bottom. Because of the raising blocks, this means it is 3" from the bottom of the tray, well out of harm's way, and also well away from the pulleys.

This part of the front panel does not connect into the oil filled gearbox so there is no problem with oil. The hard part is feeding the cord through. The cord then goes around to the back of the lathe where it plugs into a power board attached to the back of the left-hand cabinet directly under the chip tray.

This is an independent line to the one to the motor switch box, only for ease of wiring — not for any important technical reason. It does have one benefit though, the lamp doesn't dim as much when the motor load comes on.

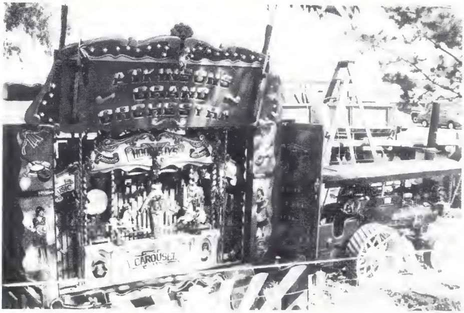
One switch controls the suds pump. The other, a spotlamp on a stand at the back of the lathe. My stand has an old truck flywheel as a heavy stable foot and has a platform at the top to suit a K-Mart adjustable cantilevered lamp stands.

This completes the modifications I have made to my geared head lathe to make it a bit more versatile and more practical to use.

Horse Power Rural Farm Day

Story and photos by Doug Baker

Real horse power! Farm skills of a bygone era were being demonstrated with perfect precision.



Graham Parkin's 4" scale free-lance traction engine coupled to a Carousel organ.

For once, the weather forecast was correct: light showers in the early morning, clearing to be sunny. The stage was set for one of the best shows I have been to in many years.

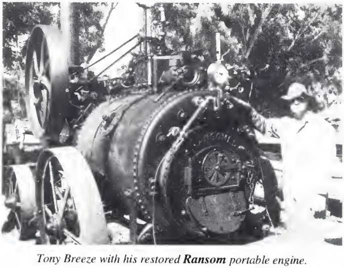
It was the Horse Power Rural Farm Day at Turner Cottage in Serpentine, 60km south of Perth. Farm skills of a bygone era were being demonstrated with perfect precision. It was almost a time warp! The exhibition, organized by the Kelmscott Agricultural Society, was specifically dedicated to horse-drawn ploughing.

While the theme was "Horse Power", vintage tractors, steam farm portable engines, miniature traction engines and vintage stationary engines were predominant. Various food and craft stalls, pony and miniature train rides were also available. There were a number of breeds of horses, but to my mind the "biological tractor", the Clydesdale, is the most magnificent working horse there is.

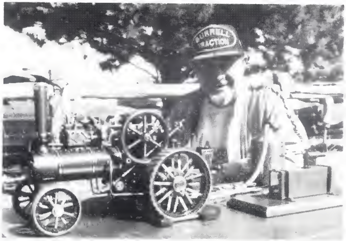
All the vintage tractors came from the Hugh Manning tractor museum, also in Serpentine. The Western Australian Vintage Machinery Preservation Society had a very impressive display of various machines, most of which were ticking over with very positive beat. Vintage stationary engines like steam engines, are fascinating things to watch, as you can see most components doing their jobs. Among these was a hot air engine purring away in perfect silence.

The Ransom portable engine has been beautifully restored and was slowly running with an exhaust note that is very difficult to describe. Basically one could hear the exhaust steam escape, followed by a wheezing. The combined rhythm of these two sounds was truly musical to a steam buff's ears. Tony Breeze, the owner/operator of this machine, was kept busy all day attending to the necessities of a steam plant, plus answering questions from the fascinated public — most of whom had never seen such a machine. There were three miniature traction engines on display, all of which were working either as a stationary exhibit, or doing serious passenger hauling.

Graham Parkin had his 4" scale traction engine of a free-lance design coupled to a Carousel organ. This Carousel organ, beautifully made in England, was an eye-catcher, as it is extremely well presented. While the acoustic pipes do not work, there is a loud



*Tony Breeze with his restored **Ransom** portable engine.*



*Jim Thompson and his recently completed 1" scale **Minnie**.*

speaker hidden away playing music typical of this machine. Despite its authenticity, it was great to watch and hear.

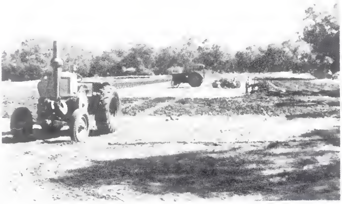
Also on display, was a recently completed 1" scale *Minnie*. This traction engine, built by Jim Thompson — a Northern Districts Model Engineering Society member, stopped the passing crowd. The sheer beauty of this traction engine — and its size — amazed most. The average person could not comprehend that such a small engine of this calibre could work on steam, let alone pull a passenger. Jim was kept busy all day with looking after his engine and answering questions. Like the other operators, he was a good ambassador for the hobby.

Ron Collins' Russian Proctor worked hard most of the day pulling an endless queue of passengers all eagerly awaiting their turn.

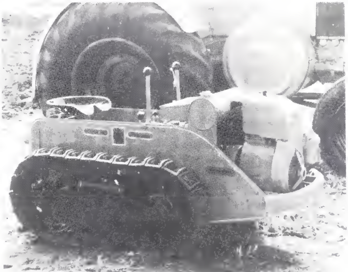
Toward the end of the day, a ½ km trip to the Hugh Manning Tractor Museum was mandatory. There is an incredible array of tractors, vintage pumps and various types of machinery. All these tractors are lovingly kept or restored to pristine condition. There is also a library of vintage tractor manuals that can be freely read, but not borrowed.

After exhausting our appetite of tractors fellow club member Ian Allison and I decided on a visit to the local pub, where we recapitulated on the day's events.

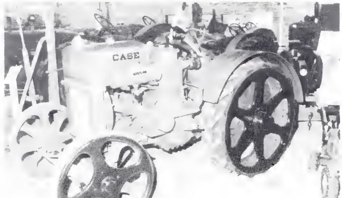
*Ron Collins tends to his Russian **Proctor** engine while an admirer looks on.*



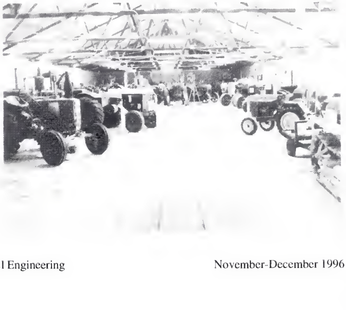
A general view of the demonstration field.



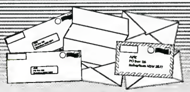
*A narrow gauge tractor? This small English **Ransomes** tracked tractor is actually a full-sized macine!*



Above and Right: *Some of the exhibits at the Hugh Manning Tractor Museum.*



Letter Box



Automatic cut-off valve correction

Sir,

I was pleased to see my article on *Automatic Steam Cut off valve for Vacuum Brakes* in the May/June issue of AME and would like to congratulate you and Peter Manning for the excellent photo and detail drawing.

However there does seem to be a slight hiccup in the text. On page 40 it reads "The bolts holding parts E and F to lever D...."etc. I think this should read "The bolts holding part F and G to lever E..." etc.

Meanwhile, keep up the good work.

Norman Deeke

Taurunga, NZ

For the Convention ladies

Sir,

I would like to advise Mrs DeJong (AME Letterbox July-August 1996), and other ladies, that the South Western Model Engineers Inc. Vic. have noticed that at various model engineers activities very little provision is made for the entertainment and other activities for the ladies.

We wish to assure the ladies coming to the 1997 convention at Cobden that we are not forgetting them or the under 18s. You will find that we have made plenty of provisions — trips, workshops, discussions etc, and seating!

Ian McArthur

Hon. Secretary, SWME

Cobden Vic

Allen Turbine centrifugal pump

Sir,

The centrifugal pump coupled to the Allen Turbine pictured on page 21 of issue No. 66 is a multistage centrifugal boiler feed pump.

These feed pumps are quite common in the sugar industry as no doubt elsewhere in steam generation plants.

The following hint may not be original but in the final profiling of coupling and motion rods, I use a router upside down and fitted with a false base and use mounted points of the approx. radius to give a ground finish to the rods (as per enclosed sketch).

(Check safe operating speed for mounted points)

Enjoy your magazine keep up the good work

David Lloyd

Qld.

Small engine supplies

Sir,

Just a short note that some of your readers may like to know. I have been to the scrap heap and have found bits that even surprised me, all the bits that is needed to build a small engine. Now I have 8mm shafts everywhere, could not get them at most places.

I have ordered a Steam engine No. 7 from E & J Winter, their response was very fast when I sent off a letter, so it shows that they have your readers at heart. Not like some big firms that I have sent letters to.

Glenn James

SA

Third Model Engineering exhibition

This is intended as a tongue-in-cheek thanks to AME for the advertising support and we thank Robert (and spouse) for their appreciation — and they weren't paid to write this either!... ed

Sir,

The Third Model Engineering exhibition held on 5 and 6 October went very well and I feel (from the public feedback) the AME advertising was a major contributor to its success.

What a mistake I made being married to a model engineer foolish enough to get tied up in helping organise a ME Exhibition. The silly fool put our phone number on the ads placed in this magazine. Night after night all I did was answer the phone from all these people wanting info about the exhibition. The kids were really cheesed off at running out to the workshop yelling "Quick dad another STD call for you". What made it worse was the bigger the ad got the more x@#%?! calls were coming in. How he could expect me to feed the kids, do the vacuuming and answer the phone all at the same time is anyone's guess!

Finally the day of reckoning came and all I could hear from people at the exhibition was "Oh you are the lady I spoke to on the phone". People from NSW, SA, WA, even one man all the way from NZ who saw the x@#%?! ad in the magazine.

As people were leaving they were saying "Oh glad we saw your Ad in the AME we must keep an eye out for when you advertise the next exhibition". All I could mutter to myself was yep you will see the next exhibition advertised but not with my phone number on it!

Motto of this story...

AME Advertising Really Works!

Name and address withheld for fear of retribution.

Robert's spouse

Vic.

US loco plans

Sir,

I liked the review of the *Locomotive Cyclopedia of American Practice* in the Sep-Oct issue. I have three other editions, and I endorse everything Clive Huggan said about this very useful book. It is a gold mine of information.

For anyone tempted to build models of *real* locomotives, I have a source of drawings of some North American locomotives that I would like to pass on. An American, Truson Buegel, has general arrangement and detail drawings collected from locomotive manufacturers, which he sells at very reasonable prices. He sends them by surface mail in a tube.

The locomotives range from small (0-6-0) to large (Big Boys). Some examples picked at random from his catalogue are: AT&SF 2900; CP Mastodon 4-8-0; C&O T-1, K-4 and H-8; C&NW Z and J; D&RGW K-36 and K-37; IC 2-10-2; Lima A-1; Nickel Plate S-3; N&W A and Y6b; Pennsy L-1-S, M-1 and J-1; thirteen SP classes; Uintah 2-6-6-2T; eight UP classes; and the US War Dept 0-6-0 and 2-8-2 (USRA). Against many components listed are cross-references to other classes ("Also used on..."), which is very useful. Some classes have detailed coverage (the D&RGW K-36 has 2½ pages); others are just a general arrangement and sections.

His steam loco plans catalogue also has a short listing of components such as those from Franklin, Mars, Nathan, Pyle-National, Westinghouse and Worthington. Additionally it lists some early diesels — EMD F-7, GP-9, DE1000; Alco PA — and some freight and passenger cars and cabooses.

Truson also includes a three-page list of other sources of drawings and photographs.

Full lists are in a 56-page *Catalog No 6*, which costs US$12.00. The address is: Truson V. Buegel Enterprises, PO Box 624, Downey, California 90241, USA. Truson's phone number is [international access code = 0011 in Australia, 00 in NZ] +1 310 869 2666. The fax number is +1 310 869 5728: make sure you put "For Truson Buegel" on it.

John Nicolson

ACT

Letterbox Contributions

Contributions of letters by mail to:
PO Box 136, Robertson, NSW, 2577 or fax to: (02) 9646 1362 are very welcome.

As far as possible, AME is an open forum for all members of our hobby. Therefore, all expressions of fact or opinion — as long as they are not libellous — will be considered for publication.

News Desk

compiled by Brian Carter

Another late issue! I have been involved in extra work hours in my day-job which has slowed down proceedings on my night-job. Just in case you don't know AME is produced in my "spare time". Due to the complexity of the production AME takes as many hours per week as my "real" job. I prefer to work on AME though (don't tell my boss!) but for that to happen we have to sell at least twice as many AME's than at present. How about encouraging your model engineering friends to buy a copy!

I would like to thank all our Crew members listed on page 5 for their valiant efforts and continued support. Without the generous donation of their time and skills there would be no AME.

Seasons Greetings

Merry Christmas and Happy New Year from the AME Crew to all our readers. We hope 1997 fulfills your modelling dreams.

New phone No at the Graham's

Neil Graham has a new phone number. The old number should be automatically diverting to the new number but the diversion hasn't been working properly. Our apologies to those who have had countless unsuccessful attempts to phone Neil or Paul.

You can now use (048) 84 4324.

Doing a good turn

We're always pleased to hear when AME has done a good turn for our fellow model engineers, even in small ways. An example came from an item in *Club Roundup* in the May-June issue. It was about the Berry Railway, a club with a beaut track about 45 minutes south of Wollongong. We put in two short paragraphs because the club isn't well known — it isn't open to the general public, although visitors always get a good welcome.

Well, the club acquired three new members as a result of the *Club Roundup* item. In a larger club that isn't many, but in a club of 25 members it's not to be sneezed at.

One new member lives less than a kilometre away in Berry village for the past six years, but hadn't known the club existed till he read about it in AME! The other two newcomers are traction engine enthusiasts, who responded to our remarks about the club's new traction engine track. Good to see!

Stolen model

George King had a Mill engine taken from the Sydney Society of Model Engineers' display case around June 1996. The Mill engine has a 2½" bore and 3" stroke. The cylinder is lagged in western red cedar held in place with brass bands. The cast iron base is mounted on a timber plinth. The engine has a brass conrod and a brass flywheel 8" diameter. If you see this model, or know where it is, please contact George on (02) 9522 7108 or AME on (02) 9649 5301.

Historical News

Further to our query on the Surrey Hills Live Steamers (AME *News Desk*, issue 67). John Elsol in Qld. wrote to report that:

"The Surrey Hills Live Steamers is now known as the Steam Locomotive Society of Victoria which is based at Morrabbin. The name was changed in the late '60s when the SHLS took a lease on the Morrabbin property. Stan Milligan of Surrey Hills was for many years the mainstay of the SHLS, hence its name. Private tracks belonging to Stan, Fred Pascoe at Frankston and Seaford and others were in use for many years.

Some 3½"g and 5"g engines from SHLS days are still in regular service — even here in Queensland!"

Hales Creek Railroad

I have received some interesting news and photos of some of the locos on the Hales Creek Railway. I'll have the article ready for the January issue.

Locomotive Cyclopedia

After our review in issue 68, Camden books have had several requests for this 1930s reprint. As a result there is a slight delay on delivery. Those who ordered one should be patient — it'll arrive eventually!

An odd engine resolved

Thanks to Doug Morrison and Ron Lucas who pointed out that the odd "inverted" engine —shown in AME issue 68, *Steam Chest*, photo 5, on page 17 — is featured in all its glory in model form on the cover of the UK *Model Engineer* issue 4020, 5 - 18 July 1996 as a lead for a construction article beginning in that issue!

The Benson vertical engine is a dead ringer to the *Steam Chest* description.

According to Anthony Mount (author of the model construction article in *Model Engineer*) the engine is possibly circa 1850s.

From the photo of the model, the skew (helical) gear is used to drive the governor, the "eccentric on the far side of the crankshaft" is used for a small water pump mounted vertically on the base. The tuning fork connecting rod is also a feature on Anthony's model, suggesting that it is part of the original equipment. Anthony's model doesn't feature the fabricated pulley but it is possible that the engine's use required the pulley on the "wrong side" of the flywheel, it seems that the engine's crankshaft was long enough to accommodate this feature.

Happy Birthday

Congratulations to the Sydney Society of Model Engineers on their 90th birthday! Story and photos in the next issue.

Classifieds

Steam Locomotives For Sale

- * Conway 3½ inch gauge 0-4-0 saddle tank engine with tender wagon. Superbly made. $3,000
  * *Kalgoorlie* 5 inch gauge 2-6-2 tank engine. Built by the late Bill Newman. Painted blue. $4,000.
  * *Jenny Lind* 5 inch gauge 2-2-2 engine and tender. Built by the late Bill Newman. $3,500.
  * *Mona* 3½ inch gauge 0-6-2 tank engine. 90% completed, has run under steam. $980.
  * 5 inch gauge 4-6-4 loco and tender. Previously used on private garden railway. $1,400.
  * 5 inch gauge 3 cylinder Shay. Previously used on private garden railway. $800.
  * G gauge Aster Baldwin 0-4-2 spirit fired loco. New. $980.
  * G gauge Adelaide Locomotive Works 0-4-0 tank loco. Spirit fired. Beautifully made. New. $900.
  Phone Peter Bick (03) 9608-7486 BH (03) 9592-6186 AH

Donkey Engines

- Plans and machining instructions available now for all four Eungella Steam single-cylinder oscillators as advertised AME Nov/Dec 1994. Plans include spirit burners and whistles. All are manufactured from stock.
  Cost $25 first plan, $20 each additional plan.
  Plans for twin-cylinder stationary and O gauge loco available shortly.
  Send cheque to Steam Projects (Aust), PO Box 839, Murwillumbah 2484 or call (066) 793306 after 6pm EST. If only requiring brochure send SAE.

Atkinson Wagon for sale

- 3" scale 6 ton Atkinson Steam Wagon Poppet Valves. POA Initial enquiries to Bob Kimber on (071) 22 3119 in Qld.

5" gauge Track for sale

- Oval with passing loop and three sidings, 35ft radius end curves. Includes 25 x 10ft straight sections (as new), 2 x LH Points and 3 RH points all built to precision standard. Sell as complete lot for $4,000. Also 1 tonne steel for track construction, price negotiable. Contact Neil on PH/Fax (048) 84 4 324

Usina Lathe for sale

- Hercus copy — 24" between centres. 4½" centre height. Quick change gearbox — Norton style. English and metric screw cutting. 6 speed Counter shaft drive. 3 and 4 jaw chuck $1750 ono. Ph Ted (02) 9484 7583

Locomotives for sale

- 7¼" gauge Hunslet (Alice class) 0-4-0 saddle tank loco. Built in Auckland NZ by top builder Brian Mould in 1986. Complete with ride-on 4 wheel tender, fitted with NZ standard copper boiler, two steam injectors, one hand pump and brakes fitted to tender plus full set of drawings. Red in colour. Price $10,000 ALSO
  5" Gauge 4-6-0 engine and tender springbox Mayflower class engine. Built in 1980 by John Heald (Rotorua) copper boiler, Black in colour good condition with full set of drawings. Price $7,000
  Please contact Terry Royan, WA, Ph (09) 399 7132 evenings and weekends.

Change gears for sale

- To suit Hercus lathe, for details phone Ray on (06) 294 1582.

7¼" gauge 0-6-0 cane loco

- Petrol powered. With ride-in eight-wheel bogie tender plus spare engine and other accessories. Very good condition. Price $3500. Phone Dave (07) 3800 7392

Traditional English Traction Engines

- Drawings, castings, accessories for 3" to 6" scale. Complete boilers supplied with pressure certificate. Machining and gear cutting service available. Send £5.00 sterling (or alternately quote credit card number and date of expiry) for catalogue and price list to Live Steam Models. Unit 7, Old Hall Mills, Little Eaton, Derbyshire. DE215DN UK Phone: ISD +44 1332 830811
  Fax: ISD +44 1332 830050.

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- VHS Instructional Videos from the USA (PAL)
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  Basic milling machine operation,
  Greensand casting techniques (foundry) Vol 1 & 2 and
  CNC X-Y-Z using car alternators (car alternators used as inexpensive power stepper motors!) $49.95 each plus $6 P&H, includes printed notes and diagrams
  * Credit cards accepted * Call Bob for more details:
  MICROCRAFT , PO Box 514 Concord, NSW, 2137
  Phone (02) 744 5440.

Subscribers Free Market

For Sale

British *Diamond* fret saw as new $500 Ph Ken (03) 9337 3907

Mamod Steam Traction Engine as new and in original pack. Best offer Ph Richard (02) 9427 4892

Macson 18 inch shaping machine $1400. McPherson Power Hacksaw $300. Phone Roy (060) 36 2450

Wanted

Delco Remy Generator made by The McKinnon Industries Limited Canada. Model No. 1833892 12 volt Serial No. K30.
Ph Les (049) 72 5251

The Book *Building the Universal Pillar Tool.*
Ph Kingsley (08) 351 7327

Australian Model Engineering magazine Issues 1 to 11 and 13 and 25. Phone Charles (042) 96 8505

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- Maximum of twenty words, including your contact name and phone number.
- Posted, on special form provided. No faxes please.
- 5" gauge or larger locomotives (for sale) are not eligible.
- Only one entry per issue.

Plough Book Sales

A History of Aircraft Piston Engines, 244 pages	$38.00
A. H. McDonald, Industrial Pioneer, 350 pages	$30.00
Diesel's Engine Vol. I, From Conception to 1918	$99.00
Old Marine Engines The World of the One-Lunger	$49.50
Australian Steam Power — Bi-Monthly magazine	$ 4.50
Guide for the Boiler Attendant's Certificate	$18.95
New Catechism of the Steam Engine (1904) 437 pages	$29.50
The Portable Steam Engine	$39.00
Elmer's Engines by Elmer Verburg, 283 pages	$82.00
Steam Engine Design (1896), 150 pages	$19.00
Steam Engine Principles Their Application,	$22.50
The European Traction Engine Register 2nd Edition	$11.00
The Last Years of Mill Engine Building, 138 pages	$37.00
The Victorian Steam Heritage Register, 200 pages	$29.00
The Story of the Britannia Iron Works, Marshall	$63.00
An Introduction to Stirling Engines, 80 pages	$19.50
Practical Notes on Hot Air Engines	$25.00
An intro to Low Temp Differential Stirling Engines	$19.50
Building the Atkinson Cycle Engine, 94 pages	$29.00
50 Perpetual Motions (1899), 30 pages	$ 7.50
507 Mechanical Movements (1893), 122 pages	$15.00
Making Charcoal and Coke, 23 pages	$ 6.00
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